

TITLE OF THE INVENTION

Method and Apparatus for Linking Designated Portions of a Received Document Image
with an Electronic Address

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BACKGROUND OF THE INVENTION

The present application is a continuation of U.S. Patent application serial
number 08/925,845, filed on September 8, 1997, which is a continuation-in-part of U.S.
Patent application serial number 08/475,204, filed on June 7, 1995, which is a
10 continuation-in-part of U.S. Patent application serial number 08/137,718, filed on
October 15, 1993, which is a continuation-in-part of U.S. Patent application serial
number 08/124,381, filed on September 17, 1993, which is a continuation of U.S. Patent
application serial number 07/918,150, filed on July 24, 1992, now abandoned, which is a
continuation of U.S. Patent application serial number 07/840,808, filed on February 25,
15 1992, now abandoned.

The present invention relates to a method and apparatus for communicating
documents with portions linked to electronic reference information. More specifically,
the present invention relates to a method and apparatus for receiving document images
and linking the received image with electronic reference information, wherein the image
20 is communicated using standard, existing equipment that otherwise would not have this
capability.

Known in the art are document management/recognition systems for facilitating
the archival storage and retrieval of documents. Some of these systems will reduce a
document down to its constituent components in the course of processing the document
25 for storage. Examples of constituent components are text fragments, graphics fragments,
bar codes, etc. In order to enable the retrieval of any given document, or to permit an
original document to be reconstructed from its parts, index information may be saved so
as to permit associations to be formed between attributes of the documents. However,
such methods do not teach the method and apparatus of the present invention.

30 Also known in the art are systems for manipulating symbolic representations of
text such as ASCII, EBCDIC, or the like, wherein embedded codes can be inserted at a

position in the text to refer to another position, or to other information associated with the position of the embedded code. The disadvantage of these systems, however, is that the document must be both created and accessed using software capable of processing the embedded codes.

5 The document images of interest herein can reside on conventional hardcopy media such as paper, and may be transmitted using nothing more than ordinary facsimile equipment designed for transmitting ordinary monochrome hardcopy documents. A distinction should be drawn between equipment sometimes referred to as "Desktop Fax" units and those called "PC-Fax" units. The former are designed to accept hardcopy
10 documents as input, which are scanned and then transmitted to a remote receiving station. The latter operate on data already in electronic format which reside in the memory of a computer; and, with respect to paper-based hardcopy, require their conversion into electronic form before operations of any kind can be performed on the contents of the hardcopy. Whereas the method taught by the present invention is not precluded from use
15 with PC-Fax equipment, it is particularly useful in connection with ordinary Desktop Fax equipment - a significant consideration in view of the limitations of such devices as compared to the capabilities possessed by the former. The present invention can thus be used by the most rudimentary of facsimile equipment, thereby imposing a minimal set of requirements on the document sender with respect to hardware and software. In contrast,
20 this is simply not possible with techniques currently known in the art. For example, techniques which rely on binary file transfer to communicate documents containing color transmit digital data files, as is evident from the name, and not document images; moreover, they mandate the use of a computer to process the data file being sent.

 The present invention is also to be distinguished from systems directed at
25 manipulating symbolic representations of document information, such as ones where text occurs in ASCII form, rather than in the form of a document image. Such systems cannot

operate on information contained in hardcopy documents until the hardcopy documents have been optically scanned and converted into machine manipulatable code by OCR software. Only then can commands of any kind be embedded into the block of symbolic data. Furthermore, appropriate hardware such as a computer, and software such as a text editor, must be available for manipulating the symbolic data. Such systems do not enable conventional facsimile equipment to be used as they lack the capacity for symbolic manipulation. Such systems clearly do not enable a sender having nothing more than a conventional monochrome facsimile machine, a hardcopy document, and a marking implement such as a pen to achieve the benefits described herein.

10 It is an object of the present invention to provide a method and apparatus for altering designated portions of a received document image that does not suffer from the drawbacks of prior art systems.

BRIEF SUMMARY OF THE INVENTION

The present invention relates to a method and apparatus for communicating documents with portions linked to electronic reference information. More specifically, the present invention relates to a method and apparatus for receiving document images and linking the received image with electronic reference information, wherein the image is communicated using standard, existing equipment that otherwise would not have this capability. For example, a standard fax machine may be used to convey a document having a portion electronically linked to electronic audio information.

The present invention comprises an apparatus for linking a document with reference information associated therewith comprising means for receiving an electronic representation of a document image, said document having a portion to be linked to electronic reference information, wherein said portion is designated by a predetermined attribute of the received document image; means for electronically scanning the electronic representation of the document image to locate said predetermined attribute of the

document image; means for identifying the linked portion of the document based on the location of said predetermined attribute; means for acquiring the electronic reference information associated with the linked portion; means for correlating the linked portion of the document with the associated electronic reference information; and means for providing
5 a pointer from the linked portion in the document to each piece of electronic reference information associated therewith.

In one embodiment of the invention, the received document image may be transmitted using standard facsimile protocols and the electronic reference information comprises audio information transmitted using standard voice channel telephony.

10 In a further embodiment of the present invention, the electronic reference information comprises address information related to the designated portion of the document image. The recipient of the document image is provided with means for receiving the document image and the electronic reference information comprising address information. The recipient's means further comprises means for accessing the address
15 information and establishing a communications session with the address or addresses associated with the designated portion of the document, which may, for example, include a voice telephone number, facsimile number, pager number, e-mail address, or a World Wide Web (WWW) address.

BRIEF DESCRIPTION OF THE DRAWINGS

20 A detailed description of preferred embodiments of the invention will be made with reference to the accompanying drawings, wherein like numerals designate corresponding parts in the several figures.

Figure 1 illustrates a known copying apparatus in schematic form.

Figure 2 depicts a preferred embodiment of the present invention mounted on top of
25 the window of the copying apparatus illustrated in Figure 1.

Figure 3 illustrates a preferred embodiment of the image-forming components of the present invention.

Figure 4 illustrates a reflective layer that is disposed adjacent to or near the image-forming element of Figure 3.

5 Figure 5 illustrates the structures shown in Figure 4 with an image present on the image-forming member (in this particular example, a set of alphabetical characters assembled into the word "Hello").

Figure 6 is a perspective view from below the copier window of the structure in Figure 5, when the illustrated embodiment of the present invention is mounted on the copy
10 board of a copier. \

Figure 7 illustrates an embodiment of the invention that can be used with copiers possessing moving copy-boards, which are common to many low cost "personal" copiers.

Figure 8 illustrates an alternate embodiment to that depicted in Figure 5 in which the image-forming element is of the emissive variety.

15 Figure 9 illustrates an embodiment of the invention in which the signal representative of the image to be printed is transmitted to the image-forming member by an "intangible mechanism" such as an infra-red beam, rf-signal, etc. (in contrast to a cable or electrical wire).

Figure 10 illustrates one possible arrangement of photodetectors on an image
20 forming tablet.

Figure 11 illustrates an installation of two different and optional Device Emulation Modules, which impart to the apparatus additional capabilities such as facsimile machine emulation.

Figure 12 illustrates an embodiment specially adapted for "forms handling" - that is,
25 the computer assisted completion of forms, wherein a form (or application) is being inserted between an image forming element and a reflective back-layer.

Figure 13 is a view of a "blank form" as seen through the image forming member.

Figure 14 illustrates an image forming member bearing information pertinent to completion of the "blank form" generated on it.

Figure 15 depicts the information appearing in Figure 14 superimposed on the
5 "blank form".

Figure 16 shows a "completed form" that was created by the apparatus of an embodiment of the present invention.

Figure 17a shows a module insertable into the apparatus 1 for reading a data storage medium comprising a first format.

10 Figure 17b shows a module insertable into the apparatus 1 for reading a data storage medium comprising a second format.

Figure 17c shows a module insertable into the apparatus 1 for reading a data storage medium comprising a third format.

Figure 17d shows a copier-print apparatus 1 on top of a photocopier. The apparatus
15 1 has a display console 100, and a receiving means 177 for receiving the modules shown in Figures 17a-c.

Figure 17e shows a copier-print apparatus with receiving means 15 for receiving user-installable option modules 16a and 16b, which are used to extend the functional capabilities of the apparatus.

20 Figure 18a shows a copier-print apparatus capable of using data from a variety of different, and mutually incompatible computer platforms.

Figure 18b shows the insertion of two modules into the copier-print apparatus.

Figures 19(a)-19(g) illustrate an example of a process that might be involved in creating a hard copy of a disk file using a tablet in accordance with the present invention.

25 Figures 20(a)-(c) illustrate an example of the versatility afforded by an embodiment of the present invention.

Figure 21 illustrates an example of the use of a tablet in printing digital photographs taken by an electronic still camera.

Figure 22 illustrates an example of the incorporation of a compatibility assurance card reader into a tablet.

5 Figure 23 illustrates an example of a feature referred to as "Pseudo-Collation".

Figure 24 illustrates an example of a hardware configuration in one embodiment of the present invention.

Figure 25 illustrates an example of the application of MicroChannel Bus architecture by a tablet so that multiple masters can be effectively supported.

10 Figure 26 illustrates an example of a process for obtaining hard copy with a tablet from data created by a software package, that is saved on a medium such as a diskette.

Figures 27 and 28 illustrate an example of an alternate method of getting data created by an applications program into a tablet.

15 Figure 29 illustrates an example of how a device controller module and a file interpreter module of a tablet might be "borrowed" by a conventional printer.

Figure 30a shows a portable computer capable of producing hard copy using a conventional photocopier from applications software run thereon.

20 Figure 30b shows a switch provided on the portable computer for enabling information to be printed using either a conventional photocopier, or a standard printer attached to the computer.

Figure 30c shows the display screen of the portable computer, with photosensors and light gasketing.

Figures 31 and 32 illustrate an embodiment of a portable computer constructed specifically to permit data to be "printed" by using a display screen with a copier.

25 Figure 33 illustrates an example of a system for optimizing the angular orientation of a hard copy image generated by an image display screen of a tablet.

Figure 34 illustrates an example of an operator's console screen that may be provided on the back of a tablet to visually illustrate a calculated skew angle.

Figure 35 illustrates an example of an alternative display in which a skew angle Ω is depicted as an arc of a circle.

5 Figure 36a shows a set of buttons used to assist in producing hard copy on a copier.

Figure 36b shows a hard copy page with an improperly positioned image. The dot D is below the top margin of the printed sheet, so the tablet must be shifted upward.

Figure 36c shows a hard copy page that has been correctly imaged by the copier, with alignment dot D at the upper margin of the printed sheet.

10 Figure 36d shows a tablet being shifted in a direction to form a correctly aligned image by a copier.

Figure 37 illustrates an example of an alternative system for optimizing the rectilinear orientation of an image on a printed page.

15 Figure 38 illustrates an example of an alternative system for optimizing the angular orientation of an image on a printed page.

Figure 39 illustrates an example of how a fax document might appear displayed on an image display screen of a fax tablet.

Figure 40 illustrates an example of a light gasket of a fax tablet.

20 Figure 41a shows a fax document that has been received by the apparatus. Electronic audio information linked to one portion of the document is being played back.

Figure 41b shows the playback of another linked audio message.

Figure 42a shows a fax tablet equipped with a document scanner for scanning hard copy documents.

Figure 42b shows a cutaway view of the fax tablet to reveal the scanning assembly.

25 Figure 42c shows the portion of the scanner assembly that processes electronic data storage media associated with hard copy documents.

Figure 42d shows the portion of the scanner assembly that processes the optical component of hard copy documents. /

Figure 43a shows examples of systems the apparatus may communicate with.

Figure 43b shows the apparatus being used with a copier.

5 Figure 43c shows a hard copy document produced by the apparatus with the copier.

Figure 44a shows the front face of a hard copy document produced by the apparatus.

Figure 44b shows the back face of a hard copy document produced by the apparatus.

10 Figure 44c shows the hard copy document of Figures 44a and 44b being processed by the scanner assembly of the apparatus.

Figure 44d shows the front face of the hard copy document after it has been processed by the apparatus.

15 Figure 44e shows the back face of the hard copy document after it has been processed by the apparatus, with an electronic data storage medium applied thereto.

Figure 45a shows the front face of a hard copy document, which already has an electronic data storage medium.

Figure 45b shows the back face of a hard copy document which already has an electronic data storage medium.

20 Figure 45c shows the apparatus processing a hard copy document which already has an electronic data storage medium.

Figure 45d shows an image on the display screen of the apparatus, which corresponds to the image on the front face of the hard copy document processed by the apparatus.

25 Figure 45e shows access of one piece of linked electronic reference information.

Figure 45f shows access of another piece of linked electronic reference information.

Figure 46a shows a document to which audio messages may be added.

Figure 46b shows defining a highlight box enclosing a portion of the document to which an audio passage may be added.

Figure 46c shows a highlight box enclosing a portion of the document to which an
5 audio passage may be added.

Figure 46d shows a completed highlight box.

Figure 47a shows a highlight box that is ready to be linked to an audio passage.

Figure 47b shows buttons used in connection with audio passages.

Figure 48 illustrates an example of a communications protocol for fax transmission.

10 Figure 49a shows a document having frames and numerals to indicate the linked portions.

Figure 49b shows a document having numerals delimiting the linked portions.

Figure 50 illustrates an example of a voice capable desktop fax unit containing an image display screen that is not touch sensitive.

15 Figure 51 illustrates an example of a cradle into which a fax tablet may be placed.

Figure 52 illustrates an example of a cradle equipped with a video camera which enables the fax tablet docked in the cradle to send, receive and display video images.

Figure 53 illustrates the use of coordinates to identify positions of link regions contained in a document having electronically linked electronic reference information
20 associated therewith.

Figure 54a illustrates a predetermined attribute of a document image in the form of numerals delimiting linked portions of the document.

Figure 54b illustrates the step of electronically scanning the electronic representation of the document image to locate the linked portion of the document.

25 Figure 54c illustrates the recording of the positions in the document where the predetermined attribute has been detected through scanning.

Figure 54d illustrates the identified link regions in a document based on the portions of the document image found to have the predetermined attribute.

Figure 55 illustrates the manual inscription of graphical identifiers in a document to designate portions of the document to be linked to electronic reference information and the resulting document with link regions where the graphical identifiers were manually placed.

Figures 56(a) and (b) illustrate the concept of a remote link, and ways of storing this information in an electronic data storage medium capable of being included on a printed document.

Figure 57 illustrates the use of a non-standard facilities frame to modify a facsimile transmission for transmitting linked electronic reference information.

Figures 58(a-d) illustrate the communications scheme of Figure 48 in greater detail.

Figure 59 illustrates the benefit of synchronizing the formatting of the hard copy document with the storage of information to an EDSM (5117) and the potential result if synchronization is not utilized (5113).

Figures 60(a) and (b) illustrate the organization of linked electronic reference information for convenient and independent accessibility.

Figures 61(a) and (b) illustrate an apparatus for playing documents having linked electronic reference information.

Figure 62 illustrates the dynamic interaction between electronic reference information and printed information appearing on a page for documents retaining electronic links to electronic reference information.

Figure 63 shows a hardcopy document that will be transmitted by a conventional facsimile machine using a standard fax transmission protocol (i.e. CCITT Group 3) as a monochrome bi-level bitmap.

Figure 64 shows the hardcopy document of Figure 63 after graphical identifiers have been added by hand to appropriate portions. The page shown in Figure 64 represents

the first of a two page document to be transmitted to the receiving apparatus of the present invention.

Figure 65 shows the second of two pages to be transmitted. The delimited portion of the page shown in Figure 65 is also to be electronically linked to electronic reference
5 information comprising audio signals.

Figure 66 is the electronic rendition of the hardcopy page in Figure 64, on an image display device of the receiving apparatus of the present invention. Portions of the displayed page are in color, even though those very same portions were transmitted in black and white by the sending station.

10 Figure 67 shows a window containing a document portion that is electronically linked to another document portion. It is also electronically linked to electronic reference information in the form of an audio passage.

Figure 68 illustrates how data associated with each pixel of a received document image is translated from a first form to a second form, to pixel-wise cause the image
15 attributes to be re-mapped.

Figure 69 shows pixel-wise image data translation applied to collections of pixels.

Figure 70 shows some grammatical examples of one syntactical flavor of a document image processing language used by the present invention.

Figure 71 shows the electronic erasure of the pixels that make up the graphical
20 identifiers graphically added to the document image.

Figure 72 shows examples of how optically encoded data may be specified in a transmitted document.

Figure 73 shows a handwritten hardcopy document containing portions to be electronically linked to electronic reference information, being fed into the scanner of a
25 conventional facsimile apparatus for transmission.

Figure 74 shows one embodiment of a fall-back contingency for providing backwards compatibility between different versions of the present invention.

Figure 75 shows another embodiment of a fall-back contingency for providing backwards compatibility between different versions of the present invention.

5 Figure 76 shows some of the choices offered by the voice menu of the receiving apparatus, for setting up the exchange of electronic reference information between sending and receiving stations.

Figure 77 shows some examples of the use of a telephone keypad to enter alphanumeric information.

10 Figure 78 shows the handwritten hardcopy document 10010 of Figure 73 after it has been received by the receiving apparatus.

Figure 79 shows a receiving apparatus constructed in accordance with the present invention establishing contact with a voice telephone number.

15 Figure 80 shows a fax document received from a conventional fax machine that has a link to electronic reference information permitting an alphanumeric paging unit to be automatically contacted.

Figure 81 shows the entry of a text message that will be sent to an alphanumeric paging unit.

20 Figure 82 shows a handwritten letter that will contain a link to a Web site when it is received by the apparatus of the present invention from a conventional fax machine.

Figure 83 shows how a telephone keypad may be used to communicate information such as Web addresses.

Figure 84 shows how a received fax document can be used to contact a Web site automatically.

25 Figure 85 shows how a document received from a conventional fax machine may be used to contact a fax-on-demand server automatically.

Figure 86 shows a document received from a fax-on-demand service, and the Web page which can be retrieved from it.

Figure 87 shows a wireless connection being made using "Dual Component Dynamic PassCode Protection."

5 Figure 88 shows one method of obtaining the Co-PIN Number within a Secure Envelope.

Figure 89a shows a Frame Control Page used to specify how different portions of a fax document are to be organized into frames. The frame control page may be manually created and used with a conventional desktop facsimile apparatus, though this is neither a
10 requirement nor a limitation.

Figure 89b shows a frame declaration for two frames comprised of two rows.

Figure 89c shows a frame declaration for two frames comprised of two columns.

Figure 90 shows examples of features which may be conveyed using the frame control language of the present invention. Figure 90a shows the language used to create
15 two frames comprised of rows.

Figure 90b shows the language used to specify a non-resizable frame.

Figure 90c shows the language used to specify omission of scroll-bars.

Figure 91a shows a frame declaration to create two frames comprised of two rows.

Figure 91b shows a prefix page used to inform the receiving apparatus 1000 that the
20 material following the prefix page belongs with the frame corresponding to the frame identified in the prefix page.

Figure 91c shows a document associated with the frame shown in the prefix page of Figure 91b.

Figure 91d shows another prefix page for the other frame declared in Figure 91a.

25 Figure 91e shows a document associated with the frame shown in the prefix page of Figure 91d.

Figure 91f shows that the receiving apparatus has partitioned the documents of Figures 91(c) and (e) into two separate frames.

Figure 92a shows a frame declaration page which also specifies frame features, followed by a prefix page.

5 Figure 92b shows a frame declaration page which does not specify frame features, followed by a prefix page which specifies frame features.

Figure 92c shows a frame declaration page which does not specify frame features, followed by a plurality of prefix pages, each of which specify some frame features.

Figure 93a shows a frame declaration sheet.

10 Figure 93b shows a prefix page for the first of two frames created by the frame declaration of Figure 93a.

Figure 93c shows a document page containing text to be used in a navigational table of contents.

15 Figure 93d shows a prefix page for the second of two frames created by the frame declaration of Figure 93a.

Figure 93e shows a set of pages associated with a first navigable portion of the total document.

Figure 93f shows a set of pages associated with a second navigable portion of the total document.

20 Figure 93g shows a set of pages associated with a third navigable portion of the total document.

Figure 94a shows the result of the receiving apparatus 1000 receiving the information presented in Figures 93(a)-(g).

25 Figure 94b shows how the selection of an item in the navigational table of contents results in access to the navigable portion of the document associated with said item.

Figure 94c shows how the selection of another item in the navigational table of contents results in access to the navigable portion of the document associated with said another item.

Figure 95 illustrates the concept of the Java Stick-Note.

5 Figure 96 illustrates how Java Stick-Notes supply dynamic or otherwise programmable content to fax pages.

Figure 97a illustrates the concept of the Java Business Card.

Figure 97b illustrates how Java Business Cards supply dynamic or otherwise programmable content to fax pages.

10 Figure 97c shows a form which may be submitted to an Internet Web site.

Figure 98a shows a frame declaration which creates three frames.

Figure 98b shows a prefix page and a page containing text belonging with the frame associated with the prefix page.

15 Figure 98c shows two (null argument) prefix pages used to specify link source accumulation.

Figure 98d shows a document and its associated prefix page.

Figure 99 shows the result when the material of Figure 98 is received by the receiving apparatus 1000.

Figure 100a shows a frame declaration which creates three frames.

20 Figure 100b shows the specification for link source accumulation.

Figure 100c shows the specification for creating a link target container.

Figure 101 shows how markup language may be derived from frame declaration data.

25 Figure 102 shows how markup language may be derived from link region and electronic reference information data.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The following detailed description is of the best presently contemplated mode of carrying out the invention. This description is not to be taken in a limiting sense, but is made merely for the purpose of illustrating the general principles of the invention. The
5 scope of the invention is best defined by the appended claims.

The general form of the invention comprises a device capable of generating an image derived from an electrical representation of an image. The device possessing the capacity to be mounted or otherwise placed in such relationship relative to a copier that said copier can reproduce the image onto a substrate such as paper.

10 The electrical signals defining the image may originate from a computer, magnetic storage device, optical storage device, or from any kind of source or electronic apparatus capable of generating, manipulating, storing, or conveying electrical signals representing displayable information. The internal components and the manner of operation of these devices are well known in the art and, in the interest of simplifying the present disclosure,
15 will not be discussed in the present disclosure.

Embodiments of the invention, in a sense, can be likened to "electronic paper" since it is usually a sheet of paper, bearing an image on it, that is placed on a copier for the purpose of being duplicated. Embodiments of the present invention, however, permit images to be easily altered or manipulated as they are of electrical origin. The function of
20 the copier is to transform the "electronic paper" image into one on "real paper", or one on other suitable substrates.

As those skilled in the art of electronic information display are aware, there are numerous means by which an image, emanating from an electrical signal representative of that image, may be fashioned. Numerous strategies embraced by that technological family
25 may be applicable to the reduction to practice of the present invention. Examples of potential image forming systems are: liquid crystal devices, gas plasma devices, fluorescent

displays, cathode ray tubes, electrophoretic displays, and filed emission displays. The particular image forming technology used to implement the invention will influence the additional components needed to enable the image forming element to function as intended; impact the resolution, contrast, and quality of the printed output; and affect the overall configuration of the apparatus. For instance, electrophoretic displays would not require back-lighting. The aforementioned considerations are appreciable to those skilled in the art.

Depicted in Figure 1 is a representation of a known copying apparatus, such as a copier. The known copying apparatus includes a body 4 and a copier window 5. In one embodiment, the invention is in the form of an image-forming tablet. As shown in Figure 2, the image-forming tablet 1 may be placed on top of a conventional copier like an ordinary document, with the copier window 5, shown in Figure 1, immediately beneath the tablet 1. An electrical cable 3 may be used to convey the signal representative of the image to the tablet 1 from a signal source 11. As described above, the signal source 11 may include a variety of devices, such as a computer, a magnetic storage device, an optical storage device, etc.. A light shield 2 may serve to reduce the leakage of ambient light through the copier window 5, and may be constructed of any suitable, compliant material.

An image forming element of the liquid crystal variety is pictured in Figure 3. The liquid crystal image forming element includes a liquid crystal image forming layer 6a, capable of forming an image 60 (in this particular example, a set of alphabetical characters assembled into the word "Hello").

Figure 4 illustrates a reflective back-layer 6b which may be provided adjacent to the liquid crystal image forming layer 6a. For purposes of clarity, the liquid crystal image forming layer 6a and the reflective back-layer 6b are depicted as being spatially separated by a significant distance in Figure 4. However, in most embodiments of the invention these layers would be relatively closely disposed to each other.

The reflective back-layer 6b may be applied directly to the back surface of the liquid crystal image forming layer 6a in the form of a coating. A primary function of the reflective back-layer 6b is to provide an albedo in the non-imaged areas of the liquid crystal layer 6a that is optically distinct from the imaged areas of the liquid crystal layer.

5 Non-imaged areas of the liquid crystal layer 6a are substantially optically transparent to radiation of wavelengths within the domain of concern. It is also possible to substitute for the reflective back-layer 6b an active, light emitting source, such as an electroluminescent panel. Back-lighting, however, increases the power consumption level.

Figure 5 depicts the elements of Figure 4 with the inclusion of an alphabetic
10 character string formed on the liquid crystal layer 6a.

Figure 6 shows a schematic view from beneath the copier window 500 of an ordinary copying apparatus 40. The structures illustrated in Figure 5 are shown positioned on top of the copier window 500, in the manner that they would be during the process of duplicating the image 60 formed by the image forming layer 6a.

15 The tablet shaped embodiment of the invention described above is fully capable of being used with low cost "personal" copiers possessing moving copy boards. An embodiment of the invention specially adapted for use with such copiers is illustrated in Figure 7. As depicted in Figure 7, the imaging element along with its supporting members is in the form of a strip 600. The strip 600 may be held in place by a structural
20 support 625, which in turn may be mounted to the body of the copier 4 by a fastener 650. Beneath the copier window 5 can be seen that part of the copier 80 which is sensing the pattern formed by the strip 600 for reproduction onto a substrate. Interposed between the image forming element 600 and the copier window 5 is a transparent copy board 7 which is the part of the copying apparatus that undergoes translational motion, and is the member
25 upon which any document to be copied is ordinarily placed.

Figure 7 is intended to demonstrate one configuration of the present invention that may be used in conjunction with low cost "personal" copiers possessing moving copy boards. It will be recognized by those skilled in the art that numerous alternative configurations are possible for such use.

5 Figure 8 illustrates an embodiment of the invention in which the image forming element is of the emissive variety; that is, of the type which emits radiation, e.g., light. Such an image forming element may, for example, employ a fluorescent display, a gas plasma display, etc. The image forming element 65, during the course of operation, may include one or more portions 65a that are not emitting light and one or more portions 65b
10 that are emitting light. It is the sum of the non-light emitting areas 65b that collectively comprises the image to be printed.

In Figure 8 the non-emitting areas 65a are seen to compose the character string "HELLO" against the background of emitting areas 65b. The photoconductor of a copier will be discharged by the light emitting portions 65b, to leave behind on the
15 photoconductor a latent image charge pattern substantially identical to that defined by regions 65a. Also shown in Figure 8 is an anti-reflective layer 70. The function of this anti-reflective layer is to reduce the amount of light emanating from the copier's internal light source that is back-reflected off of the surface of the image forming member of the apparatus of the present invention. In practice the anti-reflective layer is more likely to be
20 present as a surface coating on the image forming member. An anti-reflective layer may be included in other embodiments, such as those employing liquid crystal components.

Figure 9 is a diagrammatic representation of an arrangement where the electrical signals defining the image to be printed are transmitted by an infrared beam, rf-carrier, or other "intangible medium" from a source 300 to the apparatus of the present invention 1.
25 The point of reception of the information-bearing signal is shown as 30. The "intangible medium" that substitutes for the electrical cable or connector is indicated by 35. The

copying apparatus is designated as 4; and the webbing which shields ambient light from leaking through the tablet/copier interface is identified as 2.

Figure 11 illustrates the installation of two Device Emulation Modules into "Module Bays", 15. In Figure 11, a first module, 16a, is designed to perform a first function, and a second module, 16b, designed to perform a second, different function. An example of a function which a module 16a or 16b may perform is that of facsimile machine emulation, as described in further detail below. Whereas two Modules are shown in Figure 11, the apparatus of the present invention is not restricted to this number. Also, while some embodiments contain data storage devices such as disk drives, these are not represented in Figure 11.

Some embodiments incorporate into the apparatus the means to read directly from data storage media such as magnetic diskettes, magnetic tapes, or optical discs. This facility permits text or graphical information to be directly loaded into the apparatus and obviates the need for connection to another device such as a computer. As some embodiments of the invention may be powered by batteries, certain versions, especially when coupled with the capability to read directly from data storage media are highly self-contained and portable: requiring for operation only a conventional copier and a diskette (for instance) containing material to be printed.

An embodiment specially adapted for "forms printing" includes a modification to the spacing between image forming element 6a and reflective back-layer 6b (which were discussed earlier in connection with Figures 4 through 6).

As illustrated in Figure 12, a blank form 90 is inserted between members 6a and 6b, with the front of the blank form facing 6a. The actual spacing between members 6a and 6b may be changeable so as to accommodate forms of different thicknesses; and means may be provided to adjust the spacing to suit the inserted form. Additional means may be

provided to alter the relative positions of layers 6a and 6b to facilitate insertion and removal of blank forms, as well as to insure their proper alignment within the tablet.

Figure 13 demonstrates how blank form 90 would appear viewed through image forming member 6a, which is the copier's perspective during the reproduction process.

5 Figure 14 depicts the image forming member, 6a, with alphanumeric information, 61, generated on it. In the illustrated example, the information comprises two data fields that are pertinent to completion of blank form 90: a name, and a street address. The information may be derived from a software package such as a data base manager, a spreadsheet, or a word processor. Figure 15 portrays the visual overlay that results when
10 blank form 90 is situated behind image forming member 6a, and displayable information is present on member 6a.

Exhibited in Figure 16 is the printed output of a copier that has been used in combination with the tablet of an embodiment of the present invention operating in "forms printing" mode. It can be seen that the original blank form, 90, has been duplicated and
15 that the data discussed in connection with Figures 14 and 15 have been imprinted on the replica; they are indicated by 66. Other information, 67, relevant to the completion of blank form 90 has, in a similar manner, likewise been imprinted. The "filled out form" output by the copier is labeled 99.

In addition to serving as a portable conversion device that enables a conventional
20 copier to function as an electronic printer, high speed printing matching and even exceeding the capability of dedicated electronic printers can be achieved by using the present invention in concert with high performance copying equipment. Further, other benefits provided by such equipment including large volume printing, and elaborate paper handling facilities like collation and stapling can be conveniently tapped.

25 Not only do embodiments of the present invention permit an ordinary copier to be utilized as a computer printer, but it also enables the conventional copier to function as a

"receiving end" facsimile printer. In one embodiment a facsimile module can be plugged into the tablet to enable fax data transmitted over standard telephone lines to be intercepted, interpreted, and converted into displayable form. Once present on the image forming member, the graphical data can be reproduced by a copier. Further, it should be noted that
5 the facsimile information can be directly viewed off of the image forming member, and thus need not be printed unless desired. In this manner the present invention provides for both "optical fax" and conventional "hard copy fax", and permits the user to inspect a transmitted document in entirety before deciding whether all or only portions are to be printed. Variations on this theme include embodiments possessing document scanning
10 capabilities, so that data transmission is possible, in addition to data reception. Other embodiments are equipped with storage means so that incoming data can be saved, then printed in a time-shifted fashion at another moment.

Embodiments of the invention may possess means to detect when a copier has completed its scan cycle; that is, when an image to be duplicated has been successfully
15 captured by the copier. An example of a detection means is a photosensor 10 shown in Figure 10. Shortly after the photosensor 10 detects the flash from the copier's source of illumination, the next image, or page, is formed on the image forming member. With the next image present, the succeeding copy cycle prints the next page of information. Multiple copies of each page are handled by counting the number of flashes emanating from the
20 copier; when the count reaches the number of copies desired for that page, the next page is formed on the image forming member. The copier must be set to the total number of pages that are to be printed.

In practice it is convenient to employ four photodetectors positioned approximately at the corners of the image forming tablet. After all four photodetectors register exposure
25 to the copier's source of illumination, "page flipping" on the image forming member takes place. "Page flipping" does not take place if all of the photodetectors do not register an

exposure, since such a situation may be the result of an error condition: for example, the page on the image forming member may not have been completely scanned by the copier. As would be clear to individuals skilled in the art of circuit design, the above-described operation is easily accomplished by simple logic circuitry; which is preferably incorporated
5 into the tablet of the present invention. The method described for controlling "page flipping" applies to copiers with scanning light sources and copiers with flash type light sources with equal facility. Manual "page flipping" is also possible, but requires the sustained presence of an operator. Furthermore, it will be recognized that other types of detection means for detecting when a copying operation is being, or has been, performed
10 may be employed (e.g., thermal sensors, current or voltage sensors, etc.).

While the placement of an image forming element of one of the kinds described herein within an otherwise typical, dedicated copying tablet is possible, it has not been the objective here to propose device modifications. In contrast, the goal of the present invention is to make use of existing conventional, dedicated copying equipment to print
15 images created or stored in an electronic format that heretofore has necessitated the use of an tablet such as a "computer printer".

Examples of Option Modules, which provide device emulation means, are discussed in greater detail below in connection with Figures 17 through 32. The following discussion is divided into two parts. First, examples of some general features and operational
20 characteristics of a tablet featuring option modules are presented. Second, a treatment of some of the technical considerations involved for reducing this aspect of the invention to practice is provided.

I. EXAMPLES OF SOME OPTION MODULE CHARACTERISTICS

It is recognized that different computer platforms have different strengths.
25 Individuals skilled in the use of more than one type of machine may feel inclined to migrate from one piece of equipment to another in an effort to maximally utilize available

resources. This is especially true at universities and in research settings. One of the problems encountered by people who employ a multiplicity of platforms in their work is the need to return to each of the platforms used in order to produce hard copy. This may mean returning to a number of different and geographically segregated sites. Another
5 problem is that the software originally used to create each portion of the whole work must still be present (or available) on each of the platforms used. When hardware is shared among many users, it is not uncommon for software to be erased by people seeking to free-up disk space. This means having to re-install applications software - a potentially time consuming process.

10 One of the primary objectives of the present invention is to provide hard copy of electronic format information arising from diverse origins. Another objective is to provide hard copy of electronic format information arising from diverse origins in a manner that is flexible and accessible, even to people with non-technical backgrounds. Yet another objective of the present invention is to accomplish the above goals in a fashion that is
15 economical and user-customizable. These and other objectives are facilitated by Option Modules.

Prior to the advent of the present invention, in order to obtain hard copy of information generated by a particular type of equipment, one needed to return to, and to employ, that specific type of equipment. For instance, a diagram drawn on an Apple
20 Macintosh computer would typically necessitate the use of an Apple Macintosh computer in order for a printout to be produced. A document written on a Smith Corona dedicated word processor would require the application of such a unit for print out to be obtained. A photograph taken by a still video camera would customarily make use of a video-floppy disk printer to make the journey from electrical signals to ink on paper. Because the
25 inventory of equipment that generates electronic format data is enormous, and continuing to grow, the complexity of producing hard copy is also increasing.

The present invention employs an ordinary copier as a source of a print engine. It then builds on this with the support of Option Modules which, by providing device emulation means, transforms an ordinary copier into a universal print engine. Furthermore, because the user interface has been tailored to people having non-technical backgrounds,
5 information generated on a variety of computer platforms and devices is made accessible even to those who do not know how to operate the equipment that originally created the information.

Because a modular approach is employed, users can customize a tablet in accordance with the present invention to suit their particular printing needs. For example,
10 one who only uses an Apple Macintosh computer can install a Macintosh-only option module for printing out Mac files saved on floppy diskettes. Similarly, for those whose computing needs are met exclusively by IBM/DOS machines, only an IBM/DOS option module need be used. University libraries, on the other end of the spectrum, are likely to have installed more costly multi-platform adapters so that files originating from a range of
15 sources, such as IBM PC's, Macintoshes, Commodore Amiga's, Next Stations, Smith Corona word processors, etc. can all be printed using a library copier. Not only is the modular approach of the present invention functionally adaptable, but it is also economically flexible. Because different copiers can be used in conjunction with a single tablet, the overall system performance can be customized by the user. For example, a
20 tablet might be used with a low cost "personal copier" for ordinary print jobs. The same tablet might later be used with a high speed collating copier to print archival data from a CD-ROM. And still later, that same tablet might be employed, for example, with a "blue print" machine to print an architectural blue print. Thus, the overall system can be tuned to meet specific printing needs by varying the choice of option module and print engine -
25 the latter being conveniently and economically furnished by an ordinary copier.

Figures 17(d) and (e) illustrate an example of a tablet 1 equipped with device emulation module receiving means 15, into which option modules 16a and 16b may be inserted. Additional receiving means 177 may also be supplied in some embodiments to allow data storage device modules such as 17a, 17b, or 17c to be installed. In Figures 5 17(a)-(c), the illustrated data storage device module 17a comprises a 3.5" floppy diskette drive; the illustrated data storage device module 17b comprises an optical storage unit such as a CD-ROM drive; and the illustrated data storage device module 17c comprises a tape drive.

The illustrated device emulation controller module 16a contains a storage device 10 controller (e.g. an Apple Macintosh 3.5" diskette drive controller, an IBM 5.25" diskette drive controller, a Next machine 3.5" drive controller, etc.) to control the data storage device module 17. Depending on the data storage device module 17 installed in the tablet 1, different storage device controllers may be used. The device emulation controller module 16a may also comprise a "multi-media" storage device controller, capable of 15 controlling a range of storage device types, and thus of providing access to a plurality of data storage formats. If this is the case, then a single device emulation controller module 16a would be capable of controlling a plurality of data storage device modules 17. The device emulation controller module 16a will incorporate circuitry similar to that which may be currently found in diskette drive adapters, tape drive adapters, CD-ROM adapters, etc.

20 Also illustrated in Figure 17(e) is a second device emulation module 16b which provides the means to translate data from one format into another. The source data format would typically be the "native format" of an applications software package, such as WordPerfect, Lotus 1-2-3, Paradox, etc.. As used herein, the term "native format" means the default data storage format of the applications program that created the data. For 25 instance, "Publisher's Paintbrush", a popular paint program for IBM-compatible platforms, has "PCX" as a native storage format.

The applications file interpreter module 16b operates in concert with the storage device controller present in the device emulation controller module 16a and the data storage device module 17. The applications file interpreter module 16b enables the tablet 1 to access and then to translate (or interpret) information stored in different native formats on various data storage media into a form that may be displayed on the image display screen of the tablet 1. Once in screen displayable form, such information may be printed, as on plain paper hard copy output P by the copier 4, as illustrated in Figure 17(d).

Additionally shown in Figures 17(d) and (e) is an example of an operator's console 100, which provides a graphical user interface for the apparatus and may be found on the back of the tablet 1. The operator's console 100 may include an ATM-style touch-sensitive operator's console screen, so that intuitive or "natural" operation of the tablet 1 may be facilitated.

Figure 18(a) illustrates four 3.5" floppy diskettes 18a-18d, generated by four different computer platforms, that may be inserted into the data storage device module 17a of the tablet 1. The illustrated 3.5" floppy diskettes 18a-18d contain data saved in a variety of different and mutually incompatible formats. For example, the data on the diskette 18a was created by an IBM/DOS machine, the data on the diskette 18b was created by an Apple Macintosh, the data on the diskette 18c was created by a Next machine, and the data on the diskette 18d was created by a Commodore Amiga.

In the illustrated example, the device emulation controller module 16a is preferably a multi-format storage device controller. This eliminates the need to plug in a different, dedicated controller module prior to the insertion of each different type of diskette. If, on the other hand, it is known that the tablet 1 will only be used to reproduce documents stored in, for example, IBM/DOS format, the device emulation controller module 16a may be equipped to read only IBM/DOS format diskettes.

Techniques for enabling a device emulation controller module 16a to operate as a multi-format storage device controller are well known to those skilled in the art. That is, the capability of reading diskettes of more than one format using a single disk drive are well known. As an example, disk drive controllers that permit both Apple Macintosh and
5 IBM PC diskettes to be read have been available for some time. "Central Point Software, Inc." of Beaverton, Oregon has long been marketing a hardware adapter board for IBM compatible computers called the "Option Board" (and after 1988, the "Deluxe Option Board") that allows IBM compatible computers to read Apple Macintosh diskettes. There are other, similar diskette drive adapter manufacturers. In a somewhat similar fashion,
10 Apple Macintoshes may also read IBM/DOS diskettes. Thus, the production of a device emulation controller module 16a which would enable the tablet 1 to read diskettes from a variety of different platforms, as shown by way of example in Figures 18(a) and (b), would be well within the purview of the skilled artisan.

The file interpreter module 16b performs the function of converting data from
15 various source formats into the screen control codes used to generate displayable images on the image display screen 6a of the tablet 1. Electronic format data files are generally comprised of two components. First, there is the raw data itself. Second, there is the set of formatting instructions that describe how the raw data is to be made use of. Accessing a data storage medium, such as a magnetic diskette, is only half of the requirement for
20 being able to print native format files saved on native storage media. Interpreting, or translating, the accessed native format file is the other half.

As a familiar example, consider a word processor data file. The file may be composed of the words that constitute the document. The file may also be composed of the formatting commands, or control codes, that describe how the words are to be arranged on
25 each page of the document, how typefaces should appear and in what sizes, whether some words are underlined, and so forth. Similar concepts apply to other types of data files,

whether they originate from spread sheet programs, data base managers, paint or draw programs, etc.

The file interpreter module 16b provides the means to make sense of the data files. That is, the file interpreter module 16b provides the means to apply the formatting rules of
5 different software applications programs to the raw data contained in the data files created by such applications. The result of this action is the creation, in screen displayable form, of information formatted as it was intended to appear by the original author of the data file. The displayed information may subsequently be copied by a copier in accordance with the general principles of the present invention, as previously described.

10 Figures 19(a) through 19(g) illustrate an example of the process that might be involved in creating a hard copy of a disk file using a tablet in accordance with the present invention. The illustrated process is extremely simple, and may be performed by people with non-technical backgrounds, including people who do not know how to use a computer.

Figures 19(a) through 19(g) illustrate the images that might appear on the operator's
15 console screen 100 to guide a user in obtaining a printout P. The operator's console screen 100 depicted in Figures 19(a)-19(g) is a touch sensitive screen, similar to screens used in some automatic teller machines. The images displayed on the operator's console screen 100 lead the user through the process of selecting and printing files selected from a disk 18a inserted into the data storage device module 17a of the tablet 1.

20 The process begins with the insertion of a disk, such as an IBM/DOS format floppy disk, into a data storage device module 17a (see, for example, Figure 18(a)). Then, as shown in Figure 19(a), the operator's console screen 100 presents a listing 210 of the files detected on the inserted disk. Platform identification information 212 may also appear at the top of the operator's console screen 100.

As shown in Figure 19(b), the user may select the files to be printed by touching the touch sensitive operator's console screen 100. The selected files appear in highlight boxes 215. To de-select a chosen file, the user might simply touch the selection again. The selection would then toggle off. When the user has completed making selections, the
5 "Done" screen-button 214 may be pressed. If the user is unsure about the procedure, or requires assistance, a "HELP" screen button 247 may be provided.

As shown in Figure 19(c), a list of the selected files 217 may then be displayed, together with a list of applications software origins 219. The user may then indicate what software package was utilized to create the selected files, with the designated software
10 origins being indicated in the form of numerals 222 alongside each selected file (see Figure 19(a)). As illustrated in Figure 19(d), for example, the files "Organic3.LEC" and "Organic2.LEC" represent files created using WordPerfect software. The origin number of these files would therefore be "6. WordPerfect". The file "Organic1.LEC" represents a file created using "Ventura Publisher" software. The origin number of this file would
15 therefore be "8. Ventura Publisher". When the user has completed indicating what software package was utilized to create the selected files, the "Done" screen-button 214 may be pressed. (To return to a previous screen menu, the user may press the "Go Back" screen button 249.)

As shown in Figure 19(e), a variety of print options 224 may then be presented as
20 electives. These include, for example: multiple copies, a feature called "pseudo-collation" (described later in connection with Figure 23), separator sheets, title sheets, print halt options, printer adjustment options, etc.

As shown in Figure 19(f), the user may be presented with a print pre-commencement advisory screen 225. The advisory screen informs the user of the total
25 number of pages that will be generated, so that the copier may be adjusted accordingly. As shown in Figure 19(f), for example, the total page count is indicated as being 87. This

page count includes all page-consuming special features, such as separator sheets. As indicated in the advisory screen 225, printing may be initiated by depressing a copy start button on the copier.

As shown in Figure 19(g), the user may monitor print status during the printing
5 process. The "page number box" 232 displays the page currently being displayed on the image-forming screen of the tablet. This allows the user to know the status of the print job while the print job is taking place. To suspend the printing process, the copy cycle may be interrupted at the copier. Since, in a preferred embodiment, the tablet follows the copier by "watching out" for copy execution via sensors, halting the copier will also place the
10 tablet into suspended operation. Alternatively, a "Stop" screen button 267 may be provided to suspend printing. Resumption of printing may be initiated by depressing a "Continue" screen button 269. Figure 19(g) also shows a listing of files remaining in the print queue 234.

Figures 20(a)-(c) illustrate an example of the versatility afforded by an embodiment
15 of the present invention. Figure 20(a) shows a diskette 18a that may be inserted into a data storage device module 17a of a tablet 1. The diskette contains a word processor document that was created on an IBM/DOS machine. The hard copy output P1 and P2 produced by the copier 4 comprises text material.

As shown in Figure 20(b), another diskette 18b may subsequently be inserted into
20 the same data storage device module 17a of the tablet 1. The second diskette 18b may contain drawings that were made on another computer platform, such as an Apple Macintosh, using a program such as "Beaker", which is not available to an IBM/DOS platform. The hard copy output P3 and P4 produced by the copier 4 comprises molecular diagrams.

As shown in Figure 20(c), an ordinary textbook 73 may be copied (printed) alongside any of the above-mentioned electronic format information. The hard copy output P5 and P6 produced by the copier 4 comprises pages copied directly from the textbook 73.

All of the above printing of hard copies P1-P6 may be accomplished at the same
5 physical site, using the same equipment, and in a "continuous flow" that is both intuitive and user-friendly. Moreover, the present invention brings these capabilities to ordinary users because all of the required equipment is relatively affordable. The copier 4 may be a low-cost "personal copier". Still further, the present invention provides room for growth, as more expensive, higher performance copying equipment can be substituted at a
10 future time. The present invention is therefore highly adaptable to one's needs and resources.

Figure 21 illustrates an example of the use of a tablet 1 in printing digital photographs taken by an electronic still camera 110. The illustrated electronic still camera 110 may store pictures on 2-inch video floppy disks 18V in a standard format defined by
15 the "Electronic Still Camera Standardization Committee". The data storage device module 17V may comprise a video floppy disk reader installed in the tablet 1 to enable video floppy disks 18V to be read and printed. The hard copy output P7 comprises a paper print specimen of a photograph taken by the camera 110. The ability to create rapid photographic proofs in this manner may be desirable to organizations such as news
20 bureaus.

Figure 22 illustrates an example of the incorporation of a compatibility assurance card reader 130 into the tablet 1. One purpose of a compatibility assurance card 120 is to insure that the tablet 1 may be used to print files created by various software packages. Another purpose is to accommodate changes in data storage formats by software
25 manufacturers.

The compatibility assurance card 120 may comprise a credit-card sized element provided by software manufacturers to licensed owners of their products. For example, the manufacturer of a word processing software package might include a compatibility assurance card 120 in the package. The compatibility assurance card 120 may contain
5 information on the data storage convention utilized by the latest release of the software. Each of the formatting and control characters used by the software program when writing data to disk files would be available on the card 120. By inserting the card 120 into the card reader 130, the tablet 1 may download the storage convention information from the card into the memory of the tablet 1. This information may then be used in place of, or as
10 a supplement to, the information contained in an installed file interpreter module 16b.

A person who, for instance, utilizes a plurality of software packages in the course of conducting business might be provided with a plurality of compatibility assurance cards. In this fashion, such an individual would be assured of being able to print out data at suitably equipped copiers at field locations, at libraries, post offices, drug stores, etc. It is
15 anticipated that most people would require three or fewer compatibility assurance cards: for example, one for a word processor, one for a spread sheet program, and one for a data base manager.

Compatibility assurance cards 120 may comprise plastic cards similar to credit cards, having a magnetic recording layer in which information such as symbol tables for
20 data file translation may be retained. Compatibility assurance cards 120 may also comprise "smart cards", optical memory cards, or any other type of medium that is cost effective and that is capable of holding the required format translation instructions.

Figure 23 illustrates an example of a feature referred to as "Pseudo-Collation". "Pseudo-Collation" is a technique that permits low-end copiers that are not equipped with
25 collating capability to simulate the benefits of collation. When a tablet in accordance with the present invention is used to print multiple copies of a single document, the tablet may

handle the task as follows: the first document page is displayed and printed, the second document page is displayed and printed, the third document page is displayed and printed, and so on until the final document page is displayed and printed. The routine is then repeated a number of times, depending upon the number of copies desired.

5 Between displaying the final document page of one copy set and the first document page of the next copy set, a separator page may be displayed to the copier by the tablet. In Figure 23, for example, the separator pages are illustrated as pages 167a, 167b and 167c. Also shown in Figure 23 is a page Px preceding the separator page 167a and a page Px between the separator pages 167a and 167b. The pages Px denote complete document copy
10 sets. In the illustrated example the borders of the separator pages 167a-167c are darkened. When a stack of printed pages Pm is fanned, the dark borders of the separator pages 167a and 167b facilitate location of the document copy sets preceding and following the separator pages. This allows low-end, non-collating copiers to produce multiple copy sets of documents in a fashion that approximates true collation.

15 II. EXAMPLES OF SOME TECHNICAL CONSIDERATIONS

Option Modules, which provide device emulation means, supply a mechanism by which users may customize, expand, upgrade, and modify a tablet in accordance with the present invention. For example, a print spooler might be installed to more effectively handle large volume print needs. Option Modules further provide the capability to directly
20 access native format data files on the original medium of the devices that created them. Option Modules enable printout to be obtained using only a copier and a diskette (for example) containing data to be printed. A connection to a computer becomes unnecessary. Using a native format file reader as an illustrative example, examples of some Option Module implementations are discussed below.

25 Figure 24 illustrates an example of a hardware configuration in one embodiment of the present invention. In the illustrated embodiment, all of the components comprise part

of the tablet, with the exception of the device emulation controller module 16a, the file interpreter module 16b, and the data storage device module 17, all of which are Option Modules.

In the illustrated example, the device emulation controller module 16a comprises a "multi-media" controller capable of controlling more than one type of storage device. The device emulation controller module 16a may, for instance, be capable of controlling an Apple Macintosh 3.5" diskette drive as well as an IBM/DOS format 3.5" diskette drive. The method of accomplishing this is known in the art. Several computer peripheral manufacturers have long been marketing products that enable a single 3.5" diskette drive to read and write in the storage format of more than a single computer platform. Examples of such manufacturers are numerous, but include Central Point Software of Beaverton, Oregon, and Apple Computer, Inc. of Cupertino, California (for use by Apple). The device emulation controller module 16a is connected to the storage device module 17, and is also connected via the I/O bus 385 to the tablet 1.

The file interpreter module 16b contains a native format file interpreter. The file interpreter module 16b is also plugged into the I/O bus 385 by virtue of being installed into the module receiving bay 15. The file interpreter module 16b performs the function of converting native format files into screen displayable form. The file interpreter module 16b may comprise a ROM. The ROM may include translation tables and interpreter instructions for translating data, appearing in the native format of various applications software packages, into a single target format. The target format will ordinarily be the screen control codes 305 used by the video controller 350 to generate images on the image display screen 6a of the tablet 1.

As appreciated by persons skilled in the art, the screen control codes 305 may comprise a graphics language, such as PostScript. (The screen control codes 305 may also comprise a bitmap, rather than a true language.) If the screen control language is

PostScript, then translation may not even be required in some instances, since certain software programs permit data to be saved in this format as an output option. Techniques for translating data from one storage format into another are known in the art. Many software applications packages provide what are referred to as "Import" and "Export" facilities. These facilities are essentially software translators. Additionally, there are several software manufacturers that specifically market format conversion programs. Examples of such manufacturers are *Inset Systems*, which produces "HiJaak", and *SCC*, which produces "Software Bridge". The methods of data format conversion are therefore well established in the art.

Returning to Figure 24, a secondary processor 376 is shown having access to both the I/O bus 385 and the common bus 383. As is standard practice when a single processor has dual bus access, buffers 353 are provided to enable bus selection. The buffers 353 are similarly present for the primary processor 375, which communicates with both the common bus 383 as well as primary bus 381. A memory block 364 is present on the I/O bus 385. A subset of the memory block 364 is reserved for non-volatile memory 365. When a storage medium, such as a diskette, is placed into the data storage device module 17, the device emulation controller module 16a, under the control of the secondary processor 376, may read data from the medium. The acquired data may be placed into the memory 364. Using format translation rules provided by the file interpreter module 16b, the processor 376 may translate the native format data read from the diskette into the screen control codes (language) used by the video controller 350. The translated screen control codes may be placed into the memory 362 by the secondary processor 376. The primary processor 375 moves the translated screen control codes from the memory 362 into the local memory 360. The video controller 350 is able to access the screen codes from the memory 360 in order to generate images 60 on the image display screen 6a. While the primary processor 375 is moving data from the common memory 362 to the system

memory 360, the secondary processor 376 may continue retrieving and translating additional native format data from the data storage device module 17.

Also shown in Figure 24 is a ROM unit 367, which contains instruction code for controlling basic system operation. An EPROM may be substituted for the ROM unit 367 in some embodiments, so that new system code can be incorporated into the tablet simply by downloading the new code from a diskette into the EPROM. A non-volatile memory block 365 may be used to retain translation instructions which are supplemental to the instructions found in the file interpreter module 16b. The supplemental instructions may be downloaded from data storage media such as diskettes, which may also be accessed using the data storage device module 17. The memory units (e.g. 362, 364, 365) may be used as shadow RAM for instruction code or translation code saved in ROM (e.g. 367, the file interpreter module 16b). This may offer an improvement in overall performance of the tablet.

Figure 25 illustrates an example of the application of MicroChannel Bus architecture by the tablet so that multiple masters can be effectively supported. In this configuration either Option Module 1 or Option Module 2 can take control of the overall system from the default system 390 (master). Either Option Module 1 or Option Module 2 can control the function of the tablet. For example, an option module might be installed to operate the tablet as a "printer" that serves a computer network. In the illustrated example, Option Module 1 corresponds to the device emulation controller module 16a and Option Module 2 corresponds to the file interpreter module 16b. However, the present invention does not require that the Option Modules correspond identically to either the device emulation controller 16a or the file interpreter 16b.

Figure 26 illustrates an example of a process for obtaining hard copy with a tablet from data created by a software package, that is saved on a medium such as a diskette. In Figure 26, element 301 represents a storage medium, such as a diskette, that contains a file

that was created by an applications program. The data is in the "native" format of the applications program that created it. As used herein, the term "native" means the format customarily employed by the program for the storage of information.

Step 302 denotes the process of accessing a file on the native storage medium. This
5 involves reading the storage medium (which may be, for example, a floppy diskette). Step 302 is accomplished by having a storage device controller, appropriate for the storage format of interest, control the storage device so as to be able to access the storage medium. For example, step 302 might entail employing hardware similar to an IBM/DOS floppy diskette drive "adapter" to control a 3.5" diskette drive, so that data stored on a 3.5"
10 IBM/DOS format diskette may be read. The diskette drive "adapter" of this example may be included in the device emulation controller module 16a, and the 3.5" diskette drive may be furnished by the data storage device module 17. As mentioned earlier, the device controller module 16a may be a "multi-media" storage device controller capable of providing access to the storage media of more than one type of computer platform. Multi-
15 media controllers are familiar in the art, and the manner of their application and construction would be known to skilled artisans.

In Figure 26, element 303 represents data that has been read into the memory of the tablet. After being read into the tablet, the data may optionally be placed into another storage medium such as, for example, a fixed disk drive connected to the tablet. The data
20 303 is still in its native format. That is, for example, if the data 303 started out as a WordPerfect document file, it is still in WordPerfect file format.

Step 304 represents the step of translating the native format data into a form that can be displayed on the image forming screen of the tablet. The element 305 represents the screen control codes that the native format data is translated into in step 304. The
25 screen control codes 305 may comprise the instructions of a display language, such as PostScript. The screen control codes 305 may also comprise the bitmap of the image that

is to be displayed. In the latter case the screen control codes would not constitute a true language. The screen control codes 305 may also comprise the linguistic elements of numerous other techniques currently available for representing graphical information on display devices, including novel display languages fashioned specifically for use by the
5 tablet.

The process of translating native format data into the screen control codes, or language, used by the tablet, would depend on the choice of screen language adapted by the particular embodiment of the tablet. The principles behind translation, however, are well known to software engineers. "Import" and "Export" functions provided by many software
10 packages perform translation between different file formats. For example, users of Microsoft Word may "Import" documents created by WordPerfect, and edit them using Microsoft Word instead. Similarly, most graphics programs can read and write "BMP", "PCX", and "TIFF" file formats, regardless of the native format of the program itself. In addition to the "Import" and "Export" features built into most applications programs, are
15 the software packages that specifically provide the service of format conversion. Examples are "HiJaak" by *Inset Systems*, and "Software Bridge" by *SCC*. The principles governing format conversion are thus familiar in the art.

Step 306 of Figure 26 represents the step of image generation by the video hardware 350 of the tablet. An image 60 is displayed on the image display screen of the
20 tablet. The process by which an image may be generated from data and displayed by video hardware is ubiquitously well known. The graphics adapters of all computers perform this function.

Figures 27 and 28 illustrate examples of alternate methods of getting data created by an applications program into the tablet. As illustrated in Figure 27, a program 410 is run
25 by a computer 408. As a result of running the program 410 on the computer 408, data 412 is created. The step 409 denotes the act of sending data to a printer 415, by way of

executing a print command from within the program 410. The data 412, however, does not reach the printer 415, because it is intercepted by a TSR (Terminate but Stay Resident) Program 414a. The TSR program 414a redirects the print stream to a storage medium, such as a floppy diskette 401a. The data file recorded on the storage medium 401a may
5 contain printer control language data, since the data stream was originally intended for a printer. The step 302 involves accessing the storage medium 401a, as in Figure 26. When the storage medium 401a is read, the printer control codes are read into the memory of the tablet. The element 405 represents printer control codes in the RAM of the tablet. The step 304 involves translation of the printer control codes into the screen control codes 305.
10 As in Figure 26 screen image generation 306 causes the data to be displayed as an image 60 on the image display screen of the tablet.

Figure 28 shows another technique for getting data into the tablet. As in Figure 27, a computer 408 is shown running an applications program 410 (for instance, a spread sheet program) which generates data 412. The user executes a print command from within the
15 program 410 to send the data to a printer 415. Step 409 represents the act of sending data to a printer from within the applications program. Instead of going to the printer 415, the data stream is translated by the computer 408 into the screen control codes 305 of the tablet 1 and then written to a storage medium. The element 401b represents a storage medium, such as a diskette, containing screen control codes representative of the data that was
20 queued for printing. The element 414b represents a driver that emulates a printer driver, installed on the computer platform 408. Prior to executing the print command, the user selects from the printer setup menu of the applications program 410, "Copier Printer" as the print device. The driver 414b is then invoked when the print command is issued from the applications program 410. Rather than sending a stream of printer control language
25 codes to the printer 415, the driver 414b writes screen control codes 305 to a storage

medium, such as a magnetic diskette. Step 418 represents writing captured data to a storage medium such as a diskette.

Drivers are commonly used by software. For example, on an IBM/DOS platform running Microsoft "Windows", most applications programs have setup menus that permit the selection of any printers or devices that might be installed. By selecting a device from such a menu, a driver for controlling the selected device is selected behind the scene. When a print command is executed from within an application, the driver communicates the device control codes that operates the device. In the present case, a driver may be employed that emulates a printer driver and that sends screen control codes to a storage medium, such as a diskette, instead of sending printer control codes to a printer.

After the screen control codes have been placed onto a diskette, as in element 401b in Figure 28, the information may be accessed by reading the diskette, as in step 302. Reading the diskette places the screen control codes 305 into the tablet RAM. Step 306 involves generating an image, using the data, onto the image display screen 6a of the tablet

1. Element 60 in Figure 28 represents the displayed image.

Figure 29 illustrates an example of how the device controller module 16a and the file interpreter module 16b of the tablet 1 might be "borrowed" by a conventional printer. A printer interface adapter 201 is used to provide a means for the conventional printers 415a and 415b to acquire some of the functionality afforded by the option modules 16a and 16b. The printer interface adapter 201 is supplied with option module receiving means 155, which are analogous to the module receiving bays 15 found on tablet 1. In Figure 29, the interface unit 201 is not furnished with storage device receiving means comparable to 177 of tablet 1. Instead, one 3.5" diskette drive 197 and one 5.25" diskette drive 198 are provided in a fixed mount. The dual format disk drives 197 and 198 may be of the 42mm twin mount variety, to conserve space. An operator's console 191 may be found on the top of the unit 201. The operator's console 191 has similar characteristics to the operator's

console 100 of tablet 1. The interface unit 201 is connected to a printer 415 by an electrical cable 411.

The device controller module 16a may supply the means to control diskette drives 197 and 198. The file interpreter module 16b may supply data interpretation means, so
5 that the data files read by the disk drives 197 and 198 may be printed by the printers 415a and 415b. Because the file interpreter module 16b contains instructions for generating the screen control codes 305 of the tablet 1, a second level of translation may be required in order to properly control the printers 415a and 415b. The instructions for translating screen control codes into, for instance, HP-PCL (a printer control language) may be
10 supplied by a user-installable ROM which may be installed at the outset, when the interface unit 201 is first attached to the printer 415b. Alternate embodiments of the file interpreter module 16b may, however, be equipped with "extended" interpretation capabilities that include instructions for translating native format data into either screen control codes, or printer control codes. When the screen control codes are comprised of a language such as
15 Postscript, for example, and the printer control language is also Postscript, translation naturally would not be required. As would be recognized by persons skilled in the art, the principles of operation and construction of the interface unit 201 would be similar to the concepts presented above.

Figures 30 through 32 illustrate an embodiment of a portable computer constructed
20 specifically to permit data to be "printed" by using its display screen with a copier. As shown in Figures 30(a) and 30(c), the portable computer 535 comprises a base unit 535B and a detachable screen unit 535S having a display 56A. Around the perimeter of the display element 56A is a light gasket 502 for keeping ambient light from leaking in between the display 56A and the copier window 5. The light gasket 502 may comprise any
25 suitable, flexible material (e.g. rubber). At the corners of the display element 56A are a set of sensors 10 for detecting copy execution. A set of LED's 517 in the form of arrows

point towards the screen unit 535S. Whenever print data is being diverted to the screen unit 535S, the LED's 517 blink to indicate that a data stream is being captured by the screen unit.

A spring-loaded switch 518 may be slid to the left or to the right of a detente, center position (see Figure 30(b)). The "normal" setting 521 of the switch 518 allows data queued for printout by the computer 535 to be routed to the parallel or serial ports of the computer. In the "normal" setting 521, the execution of a print command from within an applications program would cause the data stream intended for printout to be sent to whichever output port or device has been selected in software. This is similar to what conventionally occurs when a print command is executed on an ordinary computer. The switch position 523, located to the right of the center, detente position, and having a small copier icon associated with it, causes a data stream queued for printout to be diverted to the screen unit 535S.

Figure 31 illustrates an example of the data capture process of the portable computer 535. As shown, the portable computer 535 comprises a base unit 535B and a screen unit 535S. The arrows 513 indicate that the screen unit 535S may be detached from the base unit 535B. The base unit 535B includes a system unit 503 for running applications software 410. The software program 410 creates the data 412. In screen capture mode, whenever the computer operator executes a print command from within applications program 410 to send the data 412 to the "outside world" 357 (e.g. via Lpt 1 or 2), the data stream is instead intercepted by a software daemon 514 and sent to a capture unit 555 in the screen unit 535S. "Daemons" are a member of a larger class of RAM resident software processes that "transparently" perform specific tasks in the background. Daemons and TSR's (Terminate but Stay Resident programs) may be invoked by "Hot-Key" sequences, interrupts, or by conditions that may arise during the course of normal system operation. The entire length of object code required to perform the task for which

the daemon is responsible need not be RAM resident. Rather, there may be a smaller portion of the complete code which, when activated, would load the remainder of the code which would subsequently perform the function. These concepts are familiar to software engineers. An example of a TSR (or daemon) might be a program that handles facsimile reception on a computer. When the facsimile hardware detects a call on its phone line, the TSR (or daemon) is invoked to service the incoming fax transmission. In the present case, the daemon 514 is invoked by the execution of a print command, or by an attempt to place data onto a serial or parallel port of the computer 535. The data stream that is queued for output via the serial or parallel port is instead sent to a capture unit, identified as 555 in Figure 31. The capture unit 555 is described further in connection with Figure 32.

Data sent to the memory 560 of the capture unit 555 may be in a number of different possible formats. It is possible to construct the daemon 514 to write the actual screen control codes 305 used by the video adapter into the memory 560. For instance, the daemon 514 may include a software driver that emulates a printer driver, but which is used to generate screen control codes instead of printer control codes. This is similar to a technique used by some computer facsimile programs to capture a print stream and to transmit it as a fax document, rather than to an actual printer. The Fax TSR of such devices includes a driver that writes the print data as transmission-ready fax data, rather than as a stream of printer control codes used to drive a printer. In the present case, where screen control codes are placed into the memory 560 of the screen unit 535S, the capture unit 555 would not have to perform further translation on the data before it may be interpreted by the video hardware. The capture unit may, in such instances, merely comprise the memory 560. In contrast, in some embodiments it may be preferable to have the daemon 514 place into the memory 560 print stream data in an intermediate format. For example, it may be desirable to perform compression on the data before it is placed into the memory unit 560. The purpose of writing compressed, intermediate format data

into the screen unit memory may be to permit lengthier documents to be loaded into the detachable screen unit 535S. This intermediate format data would then need to be converted into usable screen control codes by the capture unit. Also shown in Figure 31 are a video adapter 550 and a display screen 56A of the computer 535. The video adapter
5 550 uses the screen control codes 305 to generate displayable images on the display 56A.

Figure 32 illustrates an embodiment of the computer 535 in which the capture unit 555 includes logic for converting intermediate format capture data into usable screen control codes. Such may be the case where the daemon print stream diverter 514 does not write usable screen control codes into the memory 560. The top of Figure 32 illustrates the
10 system unit 503 and some peripheral devices with which it may communicate. The peripheral devices include a storage device 517, such as a fixed disk drive, and a compatibility assurance card reader 130 (an example of which is described above in connection with Figure 22). Also included is an I/O Processor 138, which acts as an intermediary between the peripheral devices 130 and 517 and the rest of the system. The
15 capture unit 555 is illustrated as being within the detachable screen unit 535S. In the illustrated configuration, the capture unit 555 includes a microprocessor 576, a ROM 516, and a memory block 560. The applications software 410 shown in Figure 31 may, in fact, be run by the system unit microprocessor 575. Moreover, the software daemon 514 may also be run by microprocessor 575. When daemon 514 re-directs print data to the capture
20 unit 555, it is actually causing the microprocessor 575 to place the data into the memory unit 560. Using the instructions contained in the ROM 516, the capture unit processor 576 translates the captured data, that was earlier placed into the memory 560, into the usable screen control codes 305. Also present in Figure 32 is a block of non-volatile memory 565. The non-volatile memory 565 may be used to retain supplements to the instructions
25 stored in the ROM unit 516. Supplemental or update information may be introduced into the non-volatile memory 565 from a diskette, or it may come from a compatibility

assurance card. In the latter case, the compatibility assurance card would be inserted into, and read by, the CAC reader 130.

The present invention enables detection of the amount of misalignment between a tablet and a copier window. The present invention further enables the use of image reorientation techniques, so that an image displayed by a tablet may be reoriented and printed by a copier as if the tablet and the copier window were in alignment, even if the tablet is initially misaligned relative to the copier window. Examples of systems for optimizing the orientation of a hard copy image generated by a tablet are discussed in greater detail below in connection with Figures 33 through 38.

Figure 33 illustrates an example of a system for optimizing the angular orientation of a hard copy image generated by an image display screen of a tablet. Figure 33 shows, in schematic form, the image display screen 6 of a tablet 1 in position on top of a copier window 5. The relative position of the image display screen 6 and the copier window 5 may be different each time the tablet 1 is placed on the copier window 5. Consequently, the image displayed by the tablet 1 may occasionally be skewed or misaligned relative to the copier window 5.

As shown in Figure 33, the tablet 1 defines a rectangle. Each of the four corners of the rectangle may be provided with a corresponding light detecting sensor S. Each one of the four sensors S may provide information to the tablet's microprocessor.

As further shown in Figure 33, the angle of skew or misalignment between the tablet 1 and the copier window 5 may be designated by Ω . If there is virtually no misalignment between the tablet 1 and the copier window 5, then Ω is approximately equal to zero.

In the embodiment illustrated in Figure 33, the light source of the copier scans across the copier window 5 in an upward direction, from the bottom of the page towards the top of the page (as shown by the upward pointing arrows t_1 , t_2 and t_3). Consequently,

each of the four sensors S is first exposed to light from the copier light source at a different point in time. As shown in Figure 33, for example, light from the copier light source will expose sensor S_0 first, sensor S_1 second, sensor S_2 third and sensor S_3 fourth. The time intervals between exposure of the different sensors S will be determined by the
5 length L , width W and angular orientation of the tablet 1.

The time at which the first sensor S_0 is exposed to the copier 4 light source may be represented by t_0 . The elapsed time between exposure of the first sensor S_0 and exposure of the second sensor S_1 may be represented by t_1 . Similarly, the elapsed time between exposure of the first sensor S_0 and the third sensor S_2 may be represented by t_2 , and the
10 elapsed time between exposure of the first sensor S_0 and the fourth sensor S_3 may be represented by t_3 .

The width W and length L of the tablet 1 are known constants that may be stored in the tablet's microprocessor. The angle Ω between the actual angular position of the image and the desired angular position of the image may be calculated by the microprocessor,
15 based upon the information received from the sensors S , in accordance with the following formula:

$$\Omega = \text{Tan}^{-1} (L/W) * (t_1 / (t_3 - t_1))$$

The microprocessor thus uses the information received from the sensors S to electronically calculate the angle Ω . Once Ω has been determined, the tablet 1 may be
20 physically rotated by the calculated angle Ω to thereby move the image to the desired angular orientation. Alternatively, the microprocessor may use the information received from the sensors S to electronically rotate the image by an angle Ω , from the image's present angular orientation to the image's desired angular orientation. Any number of known techniques may be used to electronically rotate the image by the calculated angle Ω .

Figure 34 illustrates an example of an operator's console screen 100 that may be provided on the back of the tablet 1 to visually illustrate the calculated angle Ω . The unbroken cross bars in Figure 34 depict the image's desired angular orientation. The broken cross bars depict the image's present angular orientation. The angle between the
5 unbroken and broken cross bars corresponds to the skew angle Ω .

Figure 35 illustrates an example of an alternative display in which Ω is depicted as an arc of a circle.

Figure 36 illustrates an example of a system for optimizing the rectilinear orientation of a hard copy image generated by an image display screen of a tablet. The
10 illustrated system enables the user to define one or more points on the printed page, and then move the image and/or tablet relative to the copier window so that the rectilinear orientation of the image may be optimized.

As shown in Figure 36(a), four buttons B may be provided on the back of the tablet 1. Each one of the four buttons B is associated with a corresponding one of the four edges
15 of the tablet 1. The buttons B provide data input to the tablet's microprocessor. Depressing any one of the buttons B will cause the tablet 1 to produce an image of a dot D on the image display screen. The dot image will be located on the edge of the image display screen, at a position substantially corresponding to the location of the depressed button B. The hard copy output P of the copier will then include a printed dot D at a
20 location on the page P corresponding to the depressed button B, as illustrated in Figure 36(b). Optionally, each button B on the back of the tablet 1 may include a small LED or other light generating device, so that the button B is illuminated after it is depressed.

If the image is optimally aligned, then the dot D printed on the hard copy output P will appear substantially adjacent the edge of the printed page (see Figure 36(c)). The
25 degree to which the printed dot D is spaced from the edge of the printed page P indicates

the degree to which the image must be shifted to correct the rectilinear alignment of the image (see Figure 36(b)).

Once the distance of the dot D from the edge of the page P has been determined, the tablet 1 may be physically shifted by the indicated distance to thereby move the image to the desired rectilinear orientation (see Figure 36(d)). Alternatively, the image may be shifted electronically from the image's present rectilinear orientation to the image's desired rectilinear orientation. Any number of known techniques may be used to electronically shift the image by the required distance.

Figure 37 illustrates an example of an alternative system for optimizing the rectilinear orientation of the image on the printed page. As shown in Figure 37, the back of the tablet 1 defines a rectangular frame configured to receive a printed page P from a copier. The rectangular frame defines four edges. Each of the four edges is provided with a corresponding electronic touch sensitive strip ST. The touch sensitive strips TS provide information to the tablet's microprocessor.

In the example shown in Figure 37, the strip TS₁ illustrated on the left hand edge of the frame is designated as a "FROM" strip. The strip TS₂ illustrated on the right hand edge of the frame is designated as a "TO" strip. Similarly, the strip TS₃ illustrated on the lower edge of the frame is designated as a "FROM" strip, while the strip TS₄ illustrated on the upper edge of the frame is designated as a "TO" strip.

In operation, a printed page P from a copier is first placed into the frame on the back of the tablet 1. In the example illustrated in Figure 37, the printed page P contains several lines of printed text. If the user wishes to shift the image upward, as shown in Figure 37, then the user first touches a point on the left hand "FROM" strip TS₁ corresponding to the actual location of the first line of text on the printed page P. This sends an electronic signal to the microprocessor indicating the present position of the printed image. Next, the user touches a point on the right hand "TO" strip TS₂

corresponding to the desired location of the first line of text on the printed page P. This sends an electronic signal to the microprocessor indicating the desired position of the printed image. The microprocessor then uses the information received from the "FROM" and "TO" strips to electronically shift the image upward, from the image's present
5 orientation (as indicated by the "FROM" strip signal) to the image's desired orientation (as indicated by the "TO" strip signal). Pages that are subsequently printed by the copier will provide images that are shifted upward by the indicated amount.

In a similar manner, the top and bottom edge strips may be used to reorient the printed image horizontally. If, for example, the user wishes to shift the image rightward,
10 as shown in Figure 37, then the user first touches a point on the lower edge "FROM" strip TS₃ corresponding to the actual location of the text on the printed page P. Next, the user touches a point on the upper edge "TO" strip TS₄ corresponding to the desired location of the text on the printed page P. The microprocessor then uses the information received from the "FROM" and "TO" strips to electronically shift the image rightward, from the
15 image's present orientation (as indicated by the "FROM" strip signal) to the image's desired orientation (as indicated by the "TO" strip signal). Pages that are subsequently printed by the copier will provide images that are shifted rightward by the indicated amount.

It should be appreciated that either strip of the pair of strips parallel to the length of
20 the tablet, or of the pair of strips parallel to the width of the tablet, may serve as a "FROM" strip or as a "TO" strip. The designation of "FROM" or "TO" is relative to which strip of the pair is touched first.

Figure 38 illustrates an example of an alternative system for optimizing the angular orientation of the image on the printed page P. The system for optimizing angular
25 orientation shown in Figure 38 is essentially similar to the system for optimizing rectilinear orientation shown in Figure 37.

As shown in Figure 38, the back of the tablet 1 defines a rectangular frame configured to receive a printed page P from a copier. The rectangular frame defines four edges. Each of the four edges is provided with a corresponding electronic touch sensitive strip ST. The touch sensitive strips TS provide information to the tablet's microprocessor.

5 In the example shown in Figure 38, the strip TS₁ illustrated on the left hand edge of the frame is designated as a "FROM" strip. The strip TS₂ illustrated on the right hand edge of the frame is designated as a "TO" strip. Similarly, the strip TS₃ illustrated on the lower edge of the frame is designated as a "FROM" strip, while the strip TS₄ illustrated on the upper edge of the frame is designated as a "TO" strip.

10 In operation, a printed page P from a copier is first placed into the frame on the back of the tablet 1. In the example illustrated in Figure 38, the printed page P contains several lines of printed text. If the user wishes to rotate the image clockwise by an angle θ as shown in Figure 38, then the user first touches a point on the left hand "FROM" strip TS₁ corresponding to the actual location of the first line of text on the printed page P. This
15 sends an electronic signal to the microprocessor indicating the present position of the printed image. Next, the user touches a point on the right hand "TO" strip TS₂ corresponding to the desired location of the first line of text on the printed page P. This sends an electronic signal to the microprocessor indicating the desired position of the printed image.

20 The width λ of the printed page P is a known constant that may be stored in the microprocessor memory. The vertical distance between the actual location of the image and the desired location of the image may be calculated by the microprocessor, based upon the information received from the "FROM" and "TO" strips. The desired angle of rotation θ may also be calculated by the microprocessor in accordance with the following formula:

25
$$\theta = \text{Tan}^{-1} \delta/\lambda$$

The microprocessor thus uses the information received from the "FROM" and "TO" strips to electronically rotate the image clockwise by an angle θ from the image's present angular orientation to the image's desired angular orientation. Pages that are subsequently printed by the copier will provide images that are rotated by the indicated amount.

5 Embodiments of the present invention enable a conventional copier to function as a "receiving end" facsimile printer. In one embodiment a facsimile module may be plugged into the tablet to enable fax data transmitted over standard telephone lines to be intercepted, interpreted, and converted into displayable form. Once present on an image forming screen, the graphical data may be reproduced by a copier. The facsimile information may
10 be directly viewed off of the image forming screen, and thus need not be printed unless desired.

In this manner the present invention provides for both "optical fax" and conventional "hard copy fax", and permits the user to inspect a transmitted document in its entirety before deciding whether all or only portions are to be printed. Variations on this
15 theme include embodiments possessing document scanning capabilities, so that data transmission is possible, in addition to data reception. Other embodiments may be equipped with storage means so that incoming data may be saved, then printed in a time-shifted fashion at another moment. The information received via fax transmission may include both visual information as well as audio information.

20 Examples of systems that use the present invention as a fax device are discussed in greater detail below in connection with Figures 39 through 52.

Figure 39 illustrates an example of how a fax document might appear displayed on the image display screen 6A of a fax tablet 1000. As shown in Figure 39, the fax document includes the image of a shirt, a body of handwritten text, and a telephone
25 number. Also represented in the figure is a light gasket 2, located along the perimeter of the display element 6A. The light gasket performs the function of keeping stray, ambient

light from leaking in between the display 6A of the tablet and the copier window of the copier while the tablet 1000 is being used with a copier to create hard copy.

Figure 40 illustrates an example of the light gasket 2 of the fax tablet 1000. A portion of the tablet 1000 is shown in an enlarged view to better illustrate the light gasket 2. As shown, the light gasket 2 is in the form of a soft, deformable material layer situated along the perimeter of the display element 6A, that is minutely elevated above the surface of the display screen. The light gasket 2 may be constructed of any suitable, flexible material (e.g. rubber).

Figures 41(a) and (b) illustrate an example of a procedure for retrieving "Voice Notes" from fax documents containing audio components. "Voice Notes" and "Audio Overlays" are novel features of the present fax unit. They permit an audio component, such as a note or memo dictated in the voice of a person sending a fax document, to be incorporated into otherwise conventional fax transmissions. The present invention enables audio overlays to be incorporated into hard copy fax documents. This permits voice notes to be accessible not only from just-received fax documents, but from fax documents that may have been received long ago, as well as from ones that may have been received by fax units other than the one currently in use. As will be seen, a preferred method employed by the present invention to incorporate audio signals into hard copy fax documents preserves the "look and feel" of the conventional, plain paper fax documents.

Looking now at Figure 41(a), the fax document first appearing in Figure 39 may again be seen on the display screen 6A of the fax tablet 1000. Depicted are a picture of a shirt, a body of handwritten text, and a telephone number. Both the image of the shirt 1110a and the telephone number 1110b are graphically enclosed by boxes that are darkened or otherwise highlighted. These highlighted boxes indicate that there are audio messages associated with the highlighted portions of the fax letter.

The image-forming screen 6A of the fax tablet 1000 is an ATM-style touch-sensitive screen. By touching any of the highlighted regions appearing on the screen 6A, the user may play back the audio message associated with the highlighted portion of the document. A loudspeaker (not shown) included in the tablet may be used to play back the audio
5 messages.

Figures 41(a) and (b) illustrate an example of a procedure for playing back the audio component of a fax message. By touching the highlight box 1110a enclosing the image of the shirt as shown in Figure 41(a), the user causes the tablet 1000 to play back an audio message stating that "This style comes in sizes small, medium and large. It does not
10 come in extra large." By touching the highlight box enclosing the telephone number 1110b as shown in Figure 41(b), the user will cause the tablet 1000 to play back a received audio message stating that "My fax tablet number 854-5678, in case you want to transmit voice/fax mail to me."

Figures 42(a)-(d) illustrate an example of the document scanner facility of the fax
15 tablet 1000. The document scanner facility includes both an audio sub-assembly and a conventional graphic sub-assembly. The audio assembly includes two sub-components: an audio read/write head, and an "audio patch" applicator.

In Figure 42(a), a document input tray 1120 is shown. The user would place a document into the document input tray 1120 to have the document processed by the
20 document scanner facilities. A document input through the document scanner tray 1120 is transported through the scanner assembly and exits at exit slit 1121. Figure 42(b) illustrates the removal of a part 1123 of the tablet 1000 so as to reveal the components of the scanner assembly. Figure 42(c) shows the audio components of the scanner assembly. Audio read/write means 1126 are pictured as well as an "audio patch" applicator 1124.
25 The audio read/write means 1126 performs the function of reading from and/or writing to an audio patch as a document is being transported through the scanning assembly. The

audio read/write means 1126 may comprise a magnetic read/write head, similar to those used in tape recording equipment or to those employed to store and to retrieve data onto an from computer diskettes. The "audio patch" applicator 1124 is in essence a label applicator that applies adhesive labels, having, for instance, a magnetic recording surface
5 layer coated onto the non-adhesive face, onto documents passing through the scanner pathway. Figure 42(d) shows an optical scanner 1127 on the cut-away portion 1123 of the fax tablet 1000. The optical scanner 1127 may comprise a linear photodetector array similar to those found in optical scanners currently available.

The audio patch retains information for the audio component of a fax document,
10 when the document possesses such a component. In a preferred embodiment, an audio path may comprise a small strip of flexible magnetic material, although other types of recording media may be used (e.g. optical). The substrate of an audio patch might be constructed of a flexible polymer, of treated paper, or it might be constructed of a flexible metal such as aluminum, onto which a recording medium may be applied. The audio patch applicator
15 1124 applies the audio patch to the back of a document sheet, generated by a copier. The audio patch technique of the present invention enables a fax document to retain the "look and feel" of a conventional, plain paper fax document. Yet it permits the document to retain audio information in addition to the conventional, graphical information.

An entire fax transmission, including both audio and visual information, may be
20 received by the tablet 1000 from a remote audio-capable fax unit and stored in the tablet's memory. The visual information may be played back on the tablet's image display screen, while the audio information may be played back on the tablet's loudspeaker.

Figures 43 and 44 illustrate an example of the process of producing hard copy of an entire audio-fax document that includes the associated audio messages. The tablet 1000
25 may first be placed on a copier 4 and plain paper hard copy P may be generated by the copier in a manner previously described. The plain paper hard copy P (which is similar in

appearance and mechanical properties to that produced by a conventional plain paper fax machine) may then be taken from the copier 4 and fed through the scanning assembly of the fax tablet 1000. As the sheet P is being fed through the scanning assembly, the audio patch applicator 1124 will generate an appropriate audio patch AP (based on the audio
5 information in the tablet's memory) and will apply the audio patch AP to the back of the fax document P. The audio patch AP enables the user to keep the recording of the audio portion of the fax transmission.

Figures 44(a) and (b) respectively illustrate an example of the front and back of a page P printed by the copier 4. The back of the page P is blank and has not yet received
10 an audio patch. The printed page P is fed into the scanning assembly as if the user were scanning the page for transmission. The audio patch AP is then applied to the back of the printed page P, as shown in Figure 44(e).

In an alternative embodiment, the tablet may simply create an audio patch but not apply the audio patch to the back of the printed page. In such an embodiment, the audio
15 patch may be manually applied to the back of the printed page as a separate procedure. The back of the printed page may be provided with printed guide markers to assist in positioning the audio patch.

Figure 45 illustrates an example of a system for playing back a printed page P having an audio patch AP. Figure 45(a) illustrates the front of the printed page P
20 containing both text and graphic information. Figure 45(b) illustrates the back of the printed page P to which an audio patch AP has been applied. The printed page P may be fed through the scanning assembly of the tablet 1000, as shown in Figure 45(c). The text and graphic information on the front of the printed page P may be scanned by an optical scanner 1127, in a manner well known in the art. The text and graphic information
25 scanned by the optical scanner 1127 may be stored in the memory and displayed on the display image display screen 6 (see Figure 45(d)).

The audio patch AP on the back of the printed page P may be read by an audio read/write head 1126. The audio information read by the audio read/write head 1126 may be stored in the tablet's memory and played back through the tablet's loudspeaker.

The text and graphic information displayed by the image display screen may include
5 highlight boxes (see Figures 45(e) and (f)). Touching a highlight box on the tablet's touch sensitive image display screen causes an associated audio message to be played back through the tablet's loudspeaker. This system enables the user to access the audio information of a fax transmission that may have been received years earlier, or that may have been received by another fax machine.

10 Figures 46 and 47 illustrate an example of how the audio portion of a fax document may be recorded. In Figures 46(a) a user's finger is shown on the upper left corner of what will be an audio highlight box. In Figure 46(b) the user's finger is shown dragging the bottom right corner of the forming highlight box to enclose the image of the shirt. In Figures 46(c) the image of the shirt has been completely enclosed within the borders of a
15 highlight box. Figure 46(d) portrays a completed highlight box defining a region of a fax document for which an audio message may now be recorded.

Figure 47(b) shows an enlargement of several on-screen buttons, including a screen button having the icon of a tape cassette. The screen button may blink to indicate that a region of the document has been selected (highlighted) and is awaiting the recording of an
20 audio message. The user touches the screen button having the icon of the tape cassette, to initiate the audio recording sequence, and begins speaking into a microphone supplied with the tablet. When the dictation of the audio message has been completed, the same screen button is again pressed. An audio overlay message has now been created for that particular, highlighted portion of the document. In Figure 47(a) the highlight box is
25 darkened to indicate that an audio message is present. In contrast, in Figure 46(d) the highlight box is clear, and is formed of dotted lines. This indicates that a region has been

defined for incorporation of an audio overlay, but that no audio message has yet been recorded.

While the audio overlay examples described above have involved human voice dictations, it is possible for audio overlays to comprise other forms of acoustic material.

5 For example, a fax document containing a list of musical recordings, such as a listing of compact discs, may have a few seconds of sample music included with each title listed. Other varieties of acoustical information may also be with the audio overlays of the present fax unit.

A fax tablet in accordance with the present invention may communicate via either a
10 cellular link or a conventional wire link. A fax tablet in accordance with the present invention may communicate with other, conventional fax machines that do not have audio message capabilities and that do not have image display screen capabilities.

Figure 48 illustrates an example of a communications protocol for fax transmission. The illustrated protocol enables a receiving fax unit having audio capability in accordance
15 with the present invention to be used with both prior art transmitting fax units as well as transmitting fax units having audio capability.

As illustrated in Figure 48, when the transmitting fax unit has completed transmitting conventional (i.e., non-audio) fax information, the transmitting fax unit transmits a disconnect signal ("DCN") to the receiving fax unit. A conventional receiving
20 fax unit will hang up upon receipt of such a disconnect signal.

In the illustrated example, a receiving fax unit having audio capability in accordance with the present invention will not hang up immediately upon receipt of the disconnect signal. Instead, the receiving fax unit waits for a predetermined period of time (for example, fifteen seconds). If the transmitting fax unit is an audio capable unit, then the
25 transmitting fax unit transmits an audio capable signal ("VOC") shortly after transmitting the conventional disconnect signal ("DCN"). If the audio capable receiving fax unit

receives the audio capable signal from the transmitting fax unit, then the receiving fax unit sends an audio acknowledge signal ("VOA") back to the transmitting fax unit. Then, the transmitting fax unit begins transmitting the audio component of the fax transmission. After transmission of the audio component is completed, the transmitting unit sends another
5 disconnect signal. The disconnect signal may be identical to the previously sent conventional disconnect signal ("DCN"), with the receiving fax unit being designed to hang up after receiving two cycles of disconnect signals.

When a fax tablet displays a fax transmission, it may also be programmed to label each separate highlight box with a corresponding identification letter or numeral. Figures
10 49(a) and (b) illustrate examples of highlight boxes that are labeled with small superscript identification numerals. In the illustrated example, the highlight box containing the image of the shirt has been labeled with a superscript identification numeral "1", and the highlight box containing the telephone number has been labeled with superscript identification numeral "2". The primary purpose for such identification numerals is to allow a user to
15 identify and play back specific audio messages without requiring the use of a touch sensitive image display screen.

Figure 50 illustrates an example of a voice capable desktop fax unit containing an image display screen that is not touch sensitive. In the illustrated example, if the user wanted to hear the audio message identified by the numeral "2", then the user would first
20 place the fax document having an audio patch in the scanning tray of the desktop fax unit. The user would then push a button on the operator's console that says "play voice note #02". The document would be transported through the scanning assembly and an audio read/write means in the desktop fax unit would read and play back the audio message identified by the numeral "2".

25 Figure 51 illustrates an example of a cradle C into which a fax tablet 1000 may be placed. The cradle C may provide many or all of the electrical connections between the

tablet 1000 and the outside environment. For example, the cradle C may include a phone connector for connecting the fax tablet 1000 to a phone line. The cradle C may include a computer connector for connecting the tablet 1000 with a computer or computer printer. The cradle C may also include a power supply for powering and/or charging the tablet
5 1000.

Figure 52 illustrates an example of a cradle C equipped with a video camera VC which enables the fax tablet 1000 docked in the cradle to send, receive and display video images.

Figure 53 shows a page D_p , which may either be a page of an electronic document
10 as it appears on the display screen of a device such as 1000, or an actual printed page. Portions of the page, as indicated by the dark bounding boxes, contain information that is electronically linked to electronic reference information.

A characteristic of every link region, such as LR1 and LR2 in Figure 53, is a set of information that defines its position within the document. There are many ways to
15 represent the location of a link region. One method is to employ coordinates. The zero-point of the coordinate system may be a reference position such as the top or left margin of the document page. In Figure 53 the link region LR1 is defined by the coordinates $[Xa(1), Ya(1); Xb(1), Ya(1); Xb(1), Yb(1); Xa(1), Yb(1)]$, starting at the top left vertex of the bounding box and going around the quadrangle in a clockwise direction.

20 Position information defining a link region is obtained whenever, for example, an audio highlight box is defined as illustrated in Figures 46(a) through (d). There are many ways to convey the position of a link region besides through coordinates, for instance with markers, embedded codes, recorded patterns, etc..

Figure 54 illustrates how link information stored on a printed document in the
25 manner illustrated in Figure 50 may be used to regenerate the electronic bounding boxes 1110a and 1110b of Figures 41(a) and 41(b). In Figure 54, D_{pm} represents a printed

document. Like in Figure 50, portions of the printed page contain information that is electronically linked to electronic reference data. Those portions of the page may be enclosed by printed markings having a pre-defined appearance. In both Figures 50 and 54 small superscript identification numerals are used as the delimiters of link regions.

5 For example, the superscript numeral 1 is used to identify the first link region 5011 on hardcopy page D_{pm} , and the superscript numeral 2 is used to identify the second link region 5022 on D_{pm} . When the printed page D_{pm} is scanned by a tablet 1000 as in Figure 45(c), or similarly when it is scanned by a desktop fax unit like the one pictured in Figure 50, electronic information representative of the image appearing on the printed page is
10 obtained.

 In Figure 54 5025 represents the electronic information representative of only the bottom portion of page D_{pm} . The concepts surrounding digital image representation are appreciable to individuals skilled in the art and the electronic representations may, for example, be in the form of bitmaps. Optical character recognition, or more generally,
15 pattern matching, may be performed on the electronic image data. This is illustrated using image information 5025. When the image data 5025 is scanned 5027 for the presence of patterns used to denote link region boundaries, the positions of the patterns that are successfully recognized 5029 are recorded 5031. The small superscript numeral 2 is identified 5029 as a link region delimiter, and its position is recorded 5031, as symbolized
20 by the placement of the crosshair. The other crosshairs shown in Figure 54 correspond to, and are similarly derived from, the other numeral 2 superscripts in document D_{pm} .

 The actual geometric shapes employed to designate link region boundaries may be arrived at by agreement. For example, whereas in Figures 49, 50, and 54 the shapes used are in the form of small superscript numerals, they are by no means limited to these.
25 Indeed Figure 55 illustrates an alternative in which the delimiters are in the form of brackets drawn by hand.

After all of the link region delimiters of a given group, for instance those involving the superscript numeral 2, have been identified, error detection procedures may be performed. As an example if, by convention, link regions are always confined within geometric boxes, then a software routine may be included to confirm that the shape traced
5 out by the sum of the identified link region delimiters is in fact quadrangular.

Once a link region has been identified it may be electronically associated with a piece of electronic reference information. Different linking conventions are possible. An example of an implicit method might be to associate the first link region identified on a page, where "*first*" may be interpreted in the top-down/left-right sense, with the first piece
10 of electronic reference information (electronically) associated with the document.

In Figure 54 the link region 5010 is electronically linked to a first piece of electronic reference information, and the link region 5020 is electronically linked to a second piece of electronic reference information. An example of an explicit link mechanism might be to connect the link region having the numeral 2 for delimiters on D_{pm}
15 with the second piece of available electronic reference information, regardless of the physical position of this link area on the page. Therefore, link region 5020 could be electronically linked to the second piece of electronic reference information even if it were located on top of link region 5010 in D_{scr} in Figure 54.

Figure 55 illustrates how printed documents do not have to be originally created
20 with electronically linked electronic references in mind in order to accommodate this feature. Printed document D_{pm2} may have been taken from a magazine, or in the extreme may even be a historical document - and can still be used with electronically linked electronic reference information.

In Figure 55, 5041 denotes a designated first link region, and 5042 denotes a
25 designated second link region. The link regions are identified by brackets 5050, which may be hand drawn 5055. It is not a requirement that the link area identifiers be brackets.

For instance, the superscript numerals of Figure 50 and Figure 54 may also be penciled in by hand. Similarly, the identifiers do not have to be manually drawn. They may be stamped onto D_{pm2} , or superimposed using overlays or other techniques, etc.

5 The concept illustrated in Figure 55 is the addition of link region identifiers in a step separate from the generation of the printed matter to which the identifiers are being added. After D_{pm2} is scanned as in Figure 45(c), pattern matching may be performed as described in connection with Figure 54. Bounding boxes such as 5010 and 5020 may be generated, and these may be electronically linked to electronic reference information in the manner practiced throughout this disclosure.

10 Figures 56(a) and (b) illustrate the storage of a remote link to electronically linked electronic reference information in an electronic data storage medium capable of being included on a printed document D_{pn} . The term "*Electronic Data Storage Medium*" (or EDSM) offers a more accurate description of the device element that is capable of being included on printed documents to retain or to convey electronically linked electronic
15 reference information. Where the electronic reference information is comprised of electronic audio information, the EDSM may also be referred to as an "Audio Patch". The electronically linked audio information of Figure 41 was stored in the audio patch AP of Figure 44(e) with a local link.

It is not a limitation, though, of the links stored in the Electronic Data Storage
20 Media described herein to be of the local variety. As shown in Figure 43(a) the apparatus 1000 can communicate with a variety of devices situated at remote locations via wired (line) or cellular connections. In response to such capability, it will sometimes be necessary to store remote links in the EDSM so that (portions of) printed documents may reference information that may not be saved on the EDSM included with the document.

25 Figure 56(a) shows an electronic data storage medium AP capable of being included on a printed page D_{pn} . The (EDSM) electronic data storage medium includes link

information (LI) and electronic reference information (ERI). A local link 5060 is shown which points to reference information 5061. In Figure 56(a) both the link information and the electronic reference information are depicted as being stored in a series of fields. It is preferable that at least the link information be saved in this manner, or in some other
5 comparable fashion whose objective is to enable each piece of electronic reference information to be accessible independently of any extraneous data.

As shown in Figure 50 the storage structure should permit convenient access to the electronic reference information even in the absence of a (Graphical User Interface) GUI Pointer (e.g., touch sensitive screen, mouse, electronic pen, etc.). Furthermore, it should
10 be possible to access any piece of electronic reference information without the need to refer to the original body of electronic data having the electronic links to the electronic reference information. The structure of Figure 56(a) permits this.

Two remote links are shown in Figure 56(a) and they are indicated as 5064. The first remote link is depicted as pointing to electronic reference information residing in a
15 mass storage device. Mass storage device 5071 may be a hard drive included with the desktop fax machine of Figure 50. Or, it may be a PCMCIA card present in the tablet 1000 of Figure 45. These are but two examples.

The remote link information recorded in AP includes node access requirement information (NAR). The node access requirement information may include instructions,
20 passwords, etc. in addition to the identities of any hardware or software which may be needed to enable the electronic reference information saved in the mass storage device 5071 to be retrieved.

The saved link information also includes the remote address (R_Address) of the electronic reference information such as the physical and logical drive names, directory
25 paths, etc. where they are located. Information identifying the portion of the document making the reference call may also be supplied. This is represented as 5069. A second

remote link is shown in Figure 56(a). This time it points to electronic reference information located on a network or on a remote host 5073.

5 The tablet 1000 may be in communications with such devices as seen in Figure 43(a). To illustrate this, the video sequence in Figure 52 may constitute information deposited in a voice mail box which is electronically linked to, for instance, the name appearing on a printed copy of the little girl's report card. The tablet 1000, docked in video cradle C (as in Figure 52), may access the voice mail box (as in Figure 43(a)) using a remote link stored in the electronic data storage medium AP.

10 As another example, in Figure 56(b), the execution of the command "Play Note #2", 5076, causes the second field of link information stored in AP to be read. Here, the information comprises a remote link to an on-line service 5073. NAR2 of this stored link may include the phone number of the desired on-line service, as well as any communications protocols or passwords which may be needed to establish the connection.

15 "R_Address 2" may include the sequence of commands required to enter the portion of the on-line service providing the desired reference information. Or, in an abbreviated arrangement which requires less storage space on the electronic data storage medium AP, the NAR frame may indicate the name of a complete applications module or batch file which must be available to the document playing apparatus, in order for the sought-after remote-linked reference information to be obtained.

20 5077 in Figure 56(b) represents a message which may be issued by an apparatus that is playing a document D_{pn} during the time that a remote connection is being established via a remote link. Also, 5076 may be an actual voice command spoken by the person playing document D_{pn} to, for example, a tablet 1000. This may be the case where the tablet 1000 possesses voice recognition capability.

25 Figure 57 shows the use of a Non-Standard Facilities frame by a facsimile apparatus, to tell a comparable apparatus how it will be conducting a modified facsimile

session. The NSF frame is included as an optional feature of the CCITT fax communications protocol. In Figure 57, the NSF data may include codes for designating the transmission mode, link mode, special characters in use, etc.. For example, the document image data as well as the linked reference data may be encoded as fax data and transmitted. Whereas the document image data dispatched in this fashion may still be intelligible to an unsuspecting receiving apparatus, the linked reference data may be useless unless the receiving apparatus is aware that such a (modified) transmissions scheme is being employed.

Figures 58(a-d) show the communications protocol of Figure 48 in greater detail.

Figure 58(a) outlines the general scheme of the communications protocol. The method utilizes two communications sessions, executed typically, although with some exceptions, in back-to-back sequence. The first session is referred to as the *Primary Communications Session*, and the second session is referred to as the *Secondary Communications Session*.

During the *Primary Communications Session* the document will typically be transmitted, by way of a conventional data transmission technique such as one of the CCITT fax protocols. During the *Secondary Communications Session* the electronically linked electronic reference information will typically be transmitted. This was seen in connection with Figure 48 where electronically linked audio information was sent. While the *Primary Communications Session* may involve one of the CCITT fax protocols, this is not a limitation of the present method, whose objective is to enable bi-directional communications of electronically linked electronic reference information with existing communications schemes not intended to accommodate this capability.

The document which is transmitted during the *Primary Communications Session* of Figure 58(a) may optionally include link information embedded with the document information. The electronically linked electronic reference information which is

transmitted during the *Secondary Communications Session* will usually include link information; although the link information need not be conveyed in an explicit form. That is, the link information may be manifest in the transmission and storage structure of the electronically linked electronic reference information.

5 For example, a pre-defined period of silence may separate two successive pieces of electronic reference information during their transmission; and, when stored in the electronic data storage medium which will be included on a printed document, each piece of electronic reference information may be assigned a separate storage field. For instance, the third piece of electronic reference information may be located in the third storage
10 location.

Figures 58(b)-(d) illustrate how the presently taught communications procedure enables otherwise conventional fax transmissions to include electronically linked audio information. In Figure 58(b) a document containing electronically linked electronic audio information is being sent using an existing fax protocol, such as the CCITT Group 2 or
15 Group 3 facsimile communications protocol. In the primary communications session a facsimile image of the document is transmitted in a manner consistent with the CCITT standard. Electronic data representative of the original document image is transmitted.

A novel (optional) addition of the present method involves transmitting electronic data not just representative of the original document, but representative of the original
20 document with superimposed link region delimiters like the ones shown in Figures 49, 50, 54 and 55. If the transmitting station comprises an apparatus such as the communications tablet 1000 in Figure 43, or the desktop fax unit shown in Figure 50, then the link information may be electronically superimposed onto the electronic representation of the original document by the apparatus. In the case where the transmitting station comprises a
25 conventional, current-art fax machine, the above-mentioned link information may be hand drawn as described in connection with Figure 55.

The linked audio information communicated during the secondary communications session in Figure 58(b) is being transmitted in what will be referred to as *Voice Mode*. After the fax transmission of the primary communications session has been successfully completed, the sending facsimile apparatus disengages the line. If the sending station
5 comprises a conventional fax machine, then it simply hangs up. If the sending station is an apparatus such as the tablet 1000 of Figure 43(a), then the apparatus 1000 does not hang up but instead disengages the use of the fax component of the equipment. The linked audio information is then sent as "voice data". If the sending station employed a conventional fax machine to transmit the fax portion in the primary communications session, then a
10 telephone on the same line as that fax machine may be used to send the linked audio information.

To illustrate the method, consider sending the two linked audio sequences depicted in Figure 47. After the fax machine has hung up, the sender may press a key on the key pad of the telephone she is using - for instance, the "*" key. In accordance with the
15 **DTMF** (Dual Tone Multifrequency) method, this generates a tone which is actually comprised of two frequency components: 941 Hz and 1209 Hz. A receiving apparatus such as 1000 of Figure 43(a) will detect the tone and interpret it as designating the start of transmission (in the voice band) of electronically linkable electronic (audio) reference information.

20 The remote apparatus may respond with a voice prompt such as "Ready to receive". The sender may then press the "#" button followed by the number of the linked electronic reference that will be sent, for example "1", and again followed by the "#" button. The sender then dictates the voice note over the phone, for example: "This style comes in size small, medium and large. It does not come in X-large." After the dictation of the linked
25 audio message has been completed the "#" button is again pressed. The first linked voice note has now been communicated to the remote, receiving station.

Similarly, to send the second linked audio reference shown in Figure 47, the sender would press "#2#" and speak into the phone: "My fax-tablet number is 854-5678, in case you want to transmit vice/fax mail to me." This is again followed by pressing the "#" button on the telephone keypad. After all of the linked electronic audio references have
5 been dictated, the sender presses the "*" button on the telephone keypad. The receiving apparatus 1000 will respond by offering a set of options: "Would you like to replay your voice notes?", etc.. Some versions of the receiving apparatus may hang up upon receipt of the terminal "*" tone.

The audio passages received by the apparatus 1000 may be stored in a memory unit
10 included with the apparatus, whether the memory is in the form of semiconductor RAM, magnetic or optical disk drive, or magnetic or optical tape, etc.. The apparatus may also proceed to immediately store the audio information in an electronic data storage medium AP which can be included on a printed document, as illustrated in Figure 44(e).

In the manner just described, it is possible to create and to send, using a
15 conventional facsimile machine, a document having electronically linked electronic reference information (e.g. audio passages), to a receiving apparatus such as the tablet 1000 of Figure 41 or Figure 43(a).

The present method also accommodates the situation where the sending station comprises an apparatus such as the tablet 1000 of Figure 41, and the receiving apparatus
20 comprises a conventional fax machine with telephone answering machine capability. In such a case the tablet 1000 will first transmit the document image information to the receiving station as an ordinary facsimile transmission. The actual electronic representation of the document that is transmitted may include link region delimiters such as those depicted in Figure 49 superimposed onto the original document. In this way embedded
25 links may be stored on the printed document such that portions of the printed document may be electronically re-linkable to electronic reference information at a later time. (In

some versions machine readable optical codes may be superimposed onto the original document.) This permits the linking step to be time-shifted.

After the document has been successfully transmitted to the receiving station, both stations hang up. The sending station then redials the receiving station and waits for the
5 outgoing announcement played by the telephone answering machine component of the receiving station to be completed. When the sending apparatus detects that the audio signal level coming over the telephone line from the receiving apparatus has dropped, the outgoing announcement is interpreted as complete. The sending apparatus then begins playing to the answering machine of the receiving station(over the telephone line) the audio
10 passages associated with portions of the already faxed document . The "#" tone may be played over the telephone line by the sending apparatus between successive audio passages.

Some versions of the apparatus may identify each audio passage by including the audio note number, for example, by playing the "#2#" tone prior to playing audio note 2. Other versions of the apparatus may even identify each audio note by playing an identifier
15 using a synthetic voice, for example, "Voice Note 3 follows", followed by playing voice note 3.

The present method therefore enables an ordinary fax machine working in conjunction with an ordinary telephone answering machine to send, receive, store, and to generate printed documents having portions that are electronically linked to electronic
20 reference information. Furthermore, by re-inputting the information received by the telephone answering machine into the apparatus 1000 of Figure 41, and by scanning (as in Figure 45(c)) the fax document received by the ordinary fax machine into the apparatus 1000, the linked audio information may again be accessed as illustrated in Figures 41(a) and 41(b).

25 Figure 58(c) illustrates a variation of the communications method in which a document having electronically linked electronic reference information is transmitted using

three communications modes. First, the document itself is transmitted using, for example, the CCITT Group 3 fax protocol. The transmitted document may include embedded link information in any of the ways described earlier. Next, the electronically linked electronic reference information (for example voice notes) is transmitted using two modes. A data
5 mode is used to send data including link data and a voice mode is used to send audio passages.

In accordance with Figure 58(c), two pieces of equipment (like 1000 of Figure 43(a)) may implement a multimode transmissions scheme to communicate documents having electronically linked electronic reference information. After the document portion
10 has been successfully transmitted using, for example the CCITT Group 3 fax protocol, a data modem using pre-defined settings may be used to transmit data such as that shown in Figure 56(a) stored in AP. Other forms of data may also be sent, such as computer files.

Following the data mode a transition to voice mode may be made, in which the data modem releases the line without hanging up. In the *AT Command Set* a modem command
15 such as "AT+FVo", "AT+FVoice", and "ATG" will bring about a transition to voice. Spoken information may be transmitted using voice mode, as described above in connection with Figure 58(b). The "VOC" command of Figure 48 may be transmitted at the start of data mode in Figure 58(c) by the data modem of the sending station.

One form the "VOC" command may take is a set of "*" tones of the form "*N",
20 where "N" is a one digit number from 0 to 9. For example "*1" may comprise a tone of 941 Hz and 1209 Hz followed by a tone of 697 Hz and 1209 Hz. Then minimum duration of each tone may be 75 milliseconds, and the minimum interdigit interval may also be 75 milliseconds. The tone of "*" without a following numeral may default to signify that a transition to voice mode will be made. This was seen in connection with Figure 58(b)
25 where, after the fax hardware released the telephone line, the "*" tone was used to signal the start of dictated voice notes.

The tones associated with "*3" (941 Hz and 1209 Hz plus 697 Hz and 1477 Hz) indicate to the tablet 1000 of Figure 43 that data mode is being used. This simply means that a data modem will be transmitting data over the line, which is still active, although the fax component has already disconnected from the line.

5 Figure 58(d) shows a version of the communications scheme in which two modes are employed: a facsimile mode and a data mode. The document having the electronic links to electronic reference information is sent using the facsimile mode; and the linked audio information is sent using the data mode. The fax portion of the scheme is as described earlier. The data portion is similar to the data portion in Figure 58(c), except
10 that in Figure 58(d) the audio passages themselves are transmitted as electronic data. This requires that the audio information, which may have been obtained as illustrated in Figure 47(b), be in digital form. The conversion of audio signals into digital form is well known in the art and, other than placing greater requirements on the data processing and transmissions overhead of the present method, offers many conveniences to the user. It is
15 possible to transmit many forms of electronic data besides electronic audio or video information. For example, computer files may be sent instead.

Using the methods described above it is possible to transmit documents having electronic links to a vast array of types of electronic reference information, and to do so while making use of existing equipment which otherwise would not have this capability.
20 Variations of the methods described above are also possible. For example, the electronic reference information may be transmitted prior to the transmission of the facsimile image.

Finally with regard to the presently taught communications method, it is possible for the Non-Standard Facilities (NSF) feature which is a part of the CCITT facsimile protocol to be utilized to enable an apparatus such as the tablet 1000 of Figure 43 to communicate
25 with another similar apparatus. It is also possible for the audio information, which comprises link information and audio data, to be transmitted as NSF data.

For example, a non-standard setup may involve sending audio data encoded as facsimile data. In some instances this method may even be desirable. However, to enable bi-directional compatibility between the devices presently taught and conventional devices such as ordinary fax machines, the scheme described in conjunction with Figures 48 and 58 is believed to be better. The NSF feature which is an integral part of the CCITT facsimile standard may be resorted to when it is known that comparable equipment will be used at both sending and receiving stations. The NSF feature may also be applied to supplement the methods described herein, as between two similar devices such as 1000 in Figure 43(a).

Figure 59 illustrates the synchronization of information storage (into an EDSM to be included on a printed document) with the formatting of the associated document. 5100 represents electronic data having portions that are electronically linked to electronic reference information. Some of the electronic data, represented by 5110, will be used to generate printed copy. Other parts of the electronic data, indicated by 5120, comprise electronic reference information and link information. Pathway 5113 illustrates what may occur without synchronization. AP is an electronic data storage medium capable of being included on a printed document. The data printed onto page Pg includes three reference calls to electronically linked reference information: 5134, 5136, and 5138. 5124 represents the electronic reference information associated with reference call 5134; 5126 represents the electronic reference information associated with reference call 5136; and 5128 represents the electronic reference information associated with reference call 5138. After storing the data associated with 5124 and 5126 in the electronic data storage medium AP, the remaining storage space 5127 on AP is insufficient for retaining the data associated with electronic reference information 5128.

Pathway 5117 illustrates formatting the hardcopy and partitioning the storage of electronic reference information in synchronization. Printed page Pgx has been formatted to include the information containing reference calls 5134 and 5136. The electronic

reference information 5124 and 5126, which are respectively linked to 5134 and 5136, is stored on a first electronic data storage medium AP capable of being included on page Pgx. The data which includes the reference call 5138 is printed on another page Pgy. The electronic reference information 5128 which is electronically linked to 5138 is stored in a
5 second electronic data storage medium capable of being included on the second printed page Pgy.

Figures 60(a) and (b) illustrates an example of how information may be organized so that it will not be necessary to acquire an entire body of electronic data in order to access to the electronic reference information that is electronically linked to portions of that
10 body of electronic data.

Figure 60(a) represents the electronic data having portions that are electronically linked to electronic reference information. Three link regions LR_a , LR_b , and LR_c are shown within a "primary" block of electronic reference information ERI_p . Link region LR_a is linked to electronic reference information $ERI_{a(1)}$. Similarly link region LR_b is linked to
15 $ERI_{b(1)}$, and LR_c is linked to $ERI_{c(1)}$. $ERI_{b(1)}$ itself includes a link to an electronic reference $ERI_{b(2)}$.

Given the electronic data shown in Figure 60(a), the information shown in Figure 60(b) may be (electronically identified and) obtained. The table of Figure 60(b) is offered only as an example. Other organizational schemes are possible.

20 The first horizontal row in the table identifies the access requirements of each of the nodes in the complete body of electronic data shown in Figure 60(a). The first row may be considered a Node Access Requirement Header. It may be more efficient for a printed document that includes a data storage medium containing complex, linked electronic reference information to have the information shown in Figure 60(b) readily accessible. A
25 table as shown in Figure 60(b) may be stored in the electronic data storage medium that is

included on the printed document. It may also be retained in the memory of a device such as 1000 in Figure 41, or in the memory of the desktop fax apparatus of Figure 50.

The Node Access Requirement Header may reveal the requirements which must be met in order for each of the electronic references to be accessed; for example, any supplemental hardware or software needed by the electronic reference data. Each column in the table furnishes information used to access (and to establish the link to) a piece of electronic reference information. For instance, looking at the second column, the first entry identifies any special hardware or software which may be needed to access the electronic reference information labeled $ERI_{a(1)}$ in Figure 60(a); and the second entry enables a link to $ERI_{a(1)}$ to be established. Each piece of electronically linked electronic reference information may be retrieved independently of any other information contained in the original body of electronic data. Similarly, GUI pointers are not required for access to be achieved. The example supplied in Figure 50 may make use this feature: "Play Voice Note #02".

Figures 61(a) and (b) illustrate an apparatus for playing printed documents that have electronic data storage media included thereon, such as the page P of Figures 45(a) and (b). In Figure 61(a) a printed document P is being inserted into the playing apparatus 5225. Scan window 5230 includes an optical or magnetic read head for reading the electronic data storage medium AP included on the rear surface P_b of the printed document P (as in Figure 45(b)). Cover plate 5235, which is attached to playing apparatus 5225 by a hinge 5233, comprises a liquid crystal display means. Cover plate 5235 is substantially optically transparent, and thus when closed shut over a printed document P which has been placed into the playing apparatus 5225, will permit information formed on the printed document to be viewed.

Images generated on the liquid crystal display means 5235 may be superimposed onto images formed on the printed document P. This allows graphics derived from

electronic reference information linked to portions of the printed document P to be overlaid onto the printed document. Figure 61(b) illustrates a printed document being optically scanned by playing apparatus 5225. The optical scanning mechanism 5240 may include a linear photodetector array like 1127 in Figure 42(d). Figure 61(b) also shows a backlit
5 portion 5231 of the playing apparatus 5225.

Figure 62 shows the playing apparatus 5225 playing a printed document P. The dark portion of the graph 5258 in the center of the page is formed on the liquid crystal display means of the cover plate, and is being superimposed onto the printed information of page P. The two arrows are also electronically formed images overlaid onto the printed
10 page.

The data and instructions for forming these images comprise electronic reference information saved in an electronic data storage medium affixed to the page P. The video sequence 5250 pictured at the bottom of the apparatus 5225 is similarly being formed from electronic reference information on the liquid crystal member. The person shown in the
15 video sequence is explaining the printed document P. The audio portion 5255 of the video sequence 5250 is being played in coordination with the graphical plot 5258 and the appearance of the arrows. The lower arrow is pointing to the part of the graph on the printed page, which represents "the department's prediction". The upper arrow is pointing to the part of the graph formed on the liquid crystal display means. It represents the
20 "actual outcome" spoken of by the person in the video sequence 5250.

Figure 63(a) shows a page of a hardcopy document that will be sent by a conventional facsimile machine having only monochrome capability to the receiving apparatus of the present invention. A conventional facsimile transmission protocol will be used, such as the CCITT group 3 facsimile transmission protocol. In Figure 63(a) 8400
25 represents one page out of a multi-page hardcopy document which can contain any number of pages. At the top of the page is the word "URGENT", 8440. In this illustration the

sender wishes to emphasize to the recipient of the fax transmission that the incoming document is of a high priority. Thus, the sender would like the word "URGENT", 8440, to be in red in the received document. Similarly, Figures 63 (a) and (b) contain a block of text 8420 which the author of the document (sender) considers to be of particular
5 significance. To signify this, 8420 is desired to be in green when received. The color selections mentioned are merely for illustrative purpose, and there is no substantive relevance to the particular colors chosen.

Figure 63(b) shows graphical identifiers 8470 being drawn by hand onto the document image of the hardcopy page. In actuality, any means for graphically adding the
10 identifiers may be employed. For example, they may be printed or stamped onto the document, or even added in the form of adhesively applied appliques. Also several different schemes may concurrently be employed to accomplish the task. When the document is in electronic format, the graphical identifiers may be electronically added. In Figure 63(b) the graphical identifiers 8470 are shown being manually marked 8480 onto the
15 document page 8400. The graphical identifiers are depicted as comprising delimiters in the form of double brackets. Double brackets are but one possibility, and not a limitation of the invention. For example, a highlight marker may also be used, such as one which renders the highlit portion a particular color or shade of gray. In such instances, the hardware must be able to accommodate images containing those chromatic values; for
20 example, the document scanner used to input the hardcopy document for transmission must be capable of detecting color or grayscale. The delimiters 8470 graphically added to the document image designate which portion of the received document is to have an operation performed on it. A variety of different "grammars" or conventions for a document image processing language are possible, and it thus should not be construed that the ones
25 presently suggested are limiting.

In Figures 63(a) and (b) there is a portion of the document image, 8450, that will be electronically linked to the photograph 8460 of Figure 65. Portion 8450 is located on the first page of the two page fax document being sent to the receiving apparatus, and 8460 is located on the second page. After they have been electronically linked to each other by the receiving apparatus it will be possible to access either linked portion without having to jump between the actual pages they are located on within the document. In lengthy multi-page fax documents this feature can be very convenient in facilitating the review of thematically related material.

In Figure 64, 8410 corresponds to hardcopy document page 8400 of Figure 63 after it has been completely marked up for transmission on a conventional (monochrome) facsimile machine. The sender wishes the word "URGENT", 8440, appearing in the top left corner of the document page, to be in red when received. Fig. 64 illustrates one example of a grammar for indicating the operations to be performed on the document portions 8440, 8420, and 8450. The different symbols used to designate different operations may be considered the grammar for a document image processing language. For example, the portion of the document designated 8440 will be translated into red as follows: first, portion 8440 (containing the word "URGENT") is placed in delimiters 8470 to signify to the receiving apparatus that the designated portion has to have an operation performed on it; and second, a transfer function of "R" (for red) is placed in the lower right corner of the delimited region. The black pixels in the delimited portion of the document image will be translated to red pixels. Numerous transfer functions 8490 are available for bringing about translation, or re-mapping, of document image attributes. The one just described in connection with the translation of pixel color is but one example.

There is another portion of the document image, 8420, in Figure 64 which will undergo color translation. In the case of 8420 the black pixels in the designated document portion will be remapped to green. The image attribute transfer function 8490 for the

delimited portion containing 8420 is "G". Thus when hardcopy page 8410 of Figure 64 is received by the apparatus of the present invention, the document portion 8420 will appear in green; even though the conventional fax machine which sent the page, sent it in black.

There is also a third document portion, 8450, shown in Figures 63 and 64. Unlike
5 the just-described document portions 8420 and 8440, portion 8450 will not undergo color translation. Instead, it will become the first element of a linked sequence. The numeral "1" in the upper left corner of the delimited portion containing 8450 is referred to herein as a connection identifier 8500. Such connection identifiers are used in one embodiment of the present invention to electronically link portions of multi-page documents to each other.
10 Two types of connection identifiers are utilized by the embodiment of the present invention described herein -- connection identifiers that identify the sequence to which the document portion belongs, and connection identifiers that identify the position of the particular document portion within its sequence.

Linked sequences are a novel feature of the present invention. They offer a
15 convenience to recipients of multi-page fax documents when those documents are received by the apparatus of the present invention. In a multi-page fax document there may be portions of one page which bear relevance to specific portions of other pages. At present, one can only insert a written note such as "*(See page 4, lines 55-67)*" in the vicinity of the point in the multi-page document making the reference to the indicated portion of the
20 document. The method now taught enables a plurality of linked sequences to be defined. Each linked sequence being comprised of a collection of document portions out of the complete multi-page fax transmission. Each of the individual portions within any given linked sequence presumably possesses some degree of thematic relevance to one another. When any given page is displayed the linked portions are identifiably presented in highlight
25 boxes, within marquees, or in other manners known in the art of graphical user interfaces. When a linked portions is selected, such as by clicking a mouse with the pointer over the

linked portion, a window will open containing the portion of the multi-page fax document which constitutes the next element in the linked sequence. Forward and reverse controls enable a user to advance or retreat to the next or previous element in the linked sequence. The present system thereby permits conventional facsimile machines to send multi-page fax documents containing a plurality of portions of special thematic relevance, said portions being electronically linkable to each other such that from any given linked document portion, all other linked portions may be conveniently accessed for review. In current systems, in contrast, the recipient of the multi-page fax document would have to read the "See page xx, line yy" note, manually advance to the referenced page, and then inspect the just-advanced-to page in order to manually find the position being referred to.

Fig. 64 illustrates one example of the use of delimiters and graphical codes to indicate specific operations to be performed on designated portions of a document. The particular delimiters and symbols used are not critical to the invention, all that is necessary is that the sender and recipient of the document agree in advance on how portions will be designated and the particular symbols used to identify the operation to be performed on the portion. Figure 65 shows the second page 8430 of a two-page fax document. Double bracket delimiters 8470 have been graphically added to the document image to identify a portion 8460 of the page that contains a photograph with a caption. The photograph and its caption will be the second element of the same linked sequence, in which 8450 of Figure 64 was the first element. There is only one linked sequence in the present example, but this is not a limitation of the invention, which supports a plurality of linked sequences.

In Figure 65, the portion of the document in delimiters, 8460, is to be electronically linked to electronic reference information in the form of an audio passage in the manner previously described in connection with generating electronic links to electronic reference information. A link identifier 8520, shown here as numeral "1", has been placed in the upper right corner of the delimited portion 8460 to signify that the delimited portion is to

be electronically linked to the acquired piece of electronic reference information identified (in any of the ways already taught herein) as "electronic reference number 1". In the present case the electronic reference information will be in the form of electronic audio signals, such as a musical swatch, which will be accessible for playback from 8600.

5 The left side of the delimited portion of the document image in Figure 65 contains a connection identifier in the upper left corner to identify the sequence number 8500 of the particular linked sequence. In the example there is only one linked sequence, though this is not a limitation of the invention. The sequence number 8500 of document portion 8460 in Figure 65 and the sequence number of document portion 8450 in Figure 64 are both
10 "1". This defines both portions of the document as members of "Linked Sequence #1".

 The numeral in the bottom left corner of the delimited portion 8460 is a connection identifier that identifies the position of the portion 8460 within the particular linked sequence and may be referred to as the sequence element I.D. number 8510 of linked portion 8460. In Figure 65, the linked portion 8460 has a sequence element I.D. number
15 8510 of "2" which defines portion 8460 as the second element in the linked sequence. In Figure 64, no sequence element I.D. number is shown for document portion 8450 because the first element of a linked sequence encountered in the document by the receiving apparatus is implicitly interpreted as having a sequence element I.D. number of "1". If portion 8450 of Figure 64 had been provided with a sequence element I.D. number by the
20 sender of the document, the default value of "1" would be overridden by it.

 Thus, in Figs. 64 and 65, a document image processing language has been defined as follows: double brackets are used to designate (delimit) portions of the document to be either transformed in some way, linked to another portion of the same document, or linked to electronic reference information. In the present example, the brackets delimit
25 rectangular portions of the document, but this is not a limitation of the present invention. A symbol present in the lower right hand portion of the delimited portion indicates an

operation to be performed on the text (or figure) within the brackets. The symbol (in the present example, a numeral), in the upper left hand corner is the connection identifier that identifies the particular linked sequence to which the delimited portion belongs. The symbol in the lower left hand corner (also a numeral in the present example) identifies the
5 sequence element-I.D.-number, i.e., the position of the delimited portion within the linked sequence identified by the connection identifier in the upper left hand corner. Finally, the symbol in the upper right hand corner (also a numeral in the present example) is a link identifier to designate a link to electronic reference information as previously discussed. This document image processing language is intended to be exemplary only -- the way in
10 which the portion of the document is delimited, the particular delimiters used, the locations of the symbols, and the symbols themselves may be chosen according to any convention agreed upon by the sender and recipient of the document image.

Figure 66 shows how the marked-up document 8410 of Figure 64 would appear when received by the apparatus of the present invention. Hardcopy document 8410 was
15 transmitted to the receiving apparatus of the present invention by a conventional (monochrome) facsimile machine, using a standard facsimile transmission protocol. 8530 is the electronic representation of the image of hardcopy document 8410 of Figure 64, as it might appear on the screen of an image display device 8580. 8540 is 8440 in red and 8550 is 8420 in green. 8560 is a highlight box containing document portion 8450.

20 Figure 67 shows what happens when highlight box 8560 of Figure 66 is "selected", such as by clicking on it with a mouse, or by touching it when the display device includes a touch sensitive screen -- a window 8590 is opened. The window is used to view the document portions that are within the same linked sequence as portion 8560. In the present example, when highlight box 8560 is accessed, portion 8460 of Figure 65 appears in
25 window 8590 on the image display device 8580 in electronic form 8600. But 8600 is also electronically linked to an electronic audio passage as previously discussed. Controls 8610

are thus provided for controlling the aural reproduction of the linked audio information by the audio speakers 8640.

In the example supplied herein, there is only one linked sequence, and that single linked sequence contains only two items: document portions 8450 and 8460. Still, controls
5 8620 and 8630 are provided for advancing to the next linked portion and retreating to the previous linked portion. In the present case, pressing 8630 when 8600 is in window 8590 will cause an electronic representation of 8450 to appear in place of 8600. And, pressing 8630 again will cause the image displayed in window 8590 to cycle back to 8600. Notice that in Figure 67 the electronic representation of document image 8530 is still present in
10 the background of window 8590. This is not essential and can be altered through adjusting user preference settings.

The transformation of the text within a designated portion of a document image is described with reference to Figs. 68 and 69. Figure 68(a) shows a set of pixels that might comprise a small part of a digital image. The numbers beneath each pixel denote the data
15 that represents the pixel. For purposes of illustration each pixel has been represented by a three-bit data word. It should be recognized that the present invention is in no way limited to 3-bits/pixel. As persons skilled in the art can appreciate, an 8-bit, 24-bit or other size representation may equally be used. In actuality only a single bit is needed to represent the monochrome bi-level bitmap image of Figure 68(a), as only two states are present: white
20 (0) and black (1). As an example, pixel 8650 is shown as a white, or non-printing pixel. The data 8670 associated with pixel 8650 contains all 0's because the pixel is white or non-printing. Pixels such as 8690 and 8660 are black, or printing pixels, and are represented by the data word "001".

Figure 68(b) shows the pixel-wise translation of image attributes from monochrome
25 to color in accordance with one embodiment of the present invention. When the data associated with pixel 8690 of Figure 68(a) is translated from "001" to "010", the image

attribute of pixel 8690 is translated from black to the color (or pattern) identified as 8700 in Figure 68(b). Likewise when the data associated with pixel 8660 of Figure 68(a) is translated from "001" to "100", the color (or pattern) of 8660 is re-mapped from black to the color (or pattern) of 8770 in Figure 68(b). Several additional examples of image
5 attribute translation are supplied in Figure 68(b) but without further discussion.

Figures 69(a) and (b) illustrate the transformation of pixels in a received image (Fig. 69(a)) to a displayed image (Fig. 69(b)). Figure 69(a) shows the monochrome bitmap of the word "Hi". All of the black pixels which comprise the letters "H" and "i" are represented by the data word "001", which is consistent with what was seen in Figure
10 68(a). A monochrome bi-level representation of a page of a conventional fax document containing the word "Hi" can be constituted in the manner illustrated in Figure 69(a). Figure 69(b) shows what happens when all pixels represented by data of a first form "001", are translated to data of a second form. The letter "H", 8790 in Figure 69(a), has all of its "001" pixel data words translated to "100" data words. 8800 in Figure 69(b) shows the
15 consequence of this translation of the associated image data. Similarly, the letter "i" of Figure 69(a), 8810, has all of its "001" pixels translated to "110" data words. The result is a letter "i" with the image attribute 8820 shown in Figure 69(b). Typically, image transformation is not done on an individual character basis as illustrated in Fig. 69, but transformation on a character basis is possible using the exemplary document image
20 processing language of the present invention. Alternatively, rather than displaying the document image on a display device such as a computer monitor, it may be displayed in hard copy format using a color printer.

While the image data of pixels shown in connection with Figures 68 and 69 were depicted as being comprised of 3-bit code words, this was only for purposes of simplifying
25 the illustration. Longer data words may be used. Indeed, longer data words are preferred. Longer code words permit a wider range of possible image attributes to be supported.

Figure 70 shows some examples of the use of a document image processing language to convey instructions or operations to be performed on designated portions of document images. Double bracket delimiters 8470 are used to signify that the portion of the document image within the double brackets comprises a designated portion upon which an operation is to be performed. It should be understood that this represents but one possible way to identify designated portions -- any predetermined attribute of the portion of the document image may be used. For example, a convention may be established whereby bold-face type indicates that the text should be displayed in blue, italics indicate that the text should be displayed in red, etc. In this manner, neither delimiters nor codes indicating the color for the delimited text need to be added to the document image.

In Figure 70 the designated portion DP1 is to have its black pixels translated to red as indicated by a transfer function 8490 identified as "R." Similarly, designated portion DP2 will have its black pixels translated to green as indicated by a transfer function 8490 identified as "G." Transfer function identifiers R and G convey information pertaining to the transformation of image attributes from a first form to a second form by translating, or re-mapping, image data associated with the specific pixels within the designated portion of the document image as discussed above. For example, the transfer function identified as R may translate image data words from a value of "001" to a value of "111."

In connection with DP3 of Figure 70, transfer functions 8490 are placed in position (D), in the lower right corner of the designated portion of the image. Connection identifiers are placed on the left side of designated portions, in positions (A) and (B). Connection identifiers include link sequence number 8500 and sequence element I.D. number 8510. Position (C) is used to specify electronic links to electronic reference information.

DP4 of Figure 70 has a link sequence number 8500 of "1." Thus the image information of document portion DP4 belongs to a first linked sequence. A sequence

element I.D. number is not shown which indicates that the default sequence element I.D. number of "1" is assigned to DP4. Document portion DP5 is also part of Linked Sequence "1". It has a sequence element I.D. number of "2," and thus is the second member in linked sequence "1." Note that the sequence number of DP5 is "1" and not "2." A
5 sequence number of "2" would signify that DP5 is part of a second linked sequence as opposed to the first linked sequence. DP6 is a second example of a document portion belonging to a first linked sequence, in which it is the second member of the sequence. DP6 also contains an electronic link to electronic reference information. The electronic reference information associated with DP6 may be acquired in the manner previously
10 described.

The sample document image processing language described in connection with Figure 70 also supports the case where the electronic reference information to be linked to a portion of the document image is in the form of optically encoded data imprinted on hardcopy, where the hardcopy is received as part of the incoming document stream. Using
15 DP3 ("Gates-Mail", or G-Mail) for illustration, the portion of the document image making the call to electronic reference information is marked as follows: locus-C, 8520, is provided with the number of the piece of electronic reference information to be linked to that portion of the document image, e.g. "1." Each portion of optically encoded data is marked as follows: locus-D, 8490, is marked with an "X." The symbol "X" has been
20 selected to designate optically encoded information. Locus-A, 8500, is marked with a numeral which matches the current piece of electronic reference information, e.g. "1". Therefore, locus-A for the optically encoded data portions matches Locus-C for the portion of the document image to be electronically linked to the optically encoded data; locus-B is marked with the number of the particular portion of optically encoded data - for example
25 "1" if there is only one optically encoded portion, and "1" and "2" respectively in

association with the first and second portions, where there are two optically encoded data portions. This is illustrated and described further below in connection with Figure 72.

The foregoing illustration represents one possible embodiment of a document image processing language of the present invention. Other embodiments are possible. It will also
5 be appreciated by persons skilled in the art that some of the methods taught herein may be extrapolated to document images specified using page description languages.

Figures 71(a) and 71(b) show that the delimiters graphically added to document images may be electronically erased from the electronic representations of the images they appear in. That is, the graphical identifiers added to hardcopy need not appear in their
10 received versions. Shown in Figure 71(a) are the pixels of delimiters 8830 and the "1" bits 8850 which code for them. (Single bracket delimiters are depicted in the drawing for simplicity) After the delimiters have been found by pattern matching performed on the electronic representation of the document image, the "1" bits 8850 which make up the delimiter pixels can be translated to "0" bits 8860, yielding clear, or background color
15 pixels 8840. Auto-erasure of delimiters also demonstrates that delimiters are not always necessary. In many instances document portions may be designated by a predetermined attribute of the portion. For example, the presence of a pixel density (shade) greater than a predetermined level may, by agreement between sender and recipient, denote an area to be translated into red. Thus, rather than using graphical delimiters to designate a portion
20 of text and another symbol to identify a transfer function, it is possible to simply define pixel densities as representing different colors within the document image processing language. In this manner, no symbols need be added to the document -- it is only necessary to alter the appearance of the text itself in a predetermined manner.

Figure 72 provides two examples of how optically encoded data present in the
25 transmitted document stream may be specified using the sample document image processing language disclosed herein. The optically encoded data may comprise audio or video data in

optically encoded format. In Figure 72, 8880 represents a first portion of a document image to be electronically linked to electronic data appearing in optically encoded form. Because 8880 is the first portion to be so linked, 8940 is marked with a "1". Because 8880 is to be electronically linked to optically encoded data which needs to be translated
5 into electronic format in order to be of use, 8950 is marked with an "X". The actual optically encoded data is comprised of 8890 and 8900. To designate 8890 as a piece of optically encoded data, an "X" is placed next to the lower right corner of the delimited portion, 8980 containing the optically encoded data. To designate 8890 as a piece of optically encoded data associated with the first portion (8880) of the document image
10 having an electronic link to optically encoded data, 8960 is marked "1". Similarly, 9000 is also marked with a "1" to designate 8900 as another piece of optically encoded data associated with the portion 8880 of the document image. To identify 8890 as the first of two parts of a single unified piece of optically encoded data, 8970 is marked with a "1". The sample image processing language of the present invention permits each piece of
15 optically encoded data to be comprised of a plurality of parts. In the example in Figure 72, the optically encoded data is comprised of two parts: 8890 and 8900. The second part 8900 of the single piece of optically encoded data associated with document portion 8880 is marked with a "2", 9010, in the lower left of the image portion containing 8900. The second example of Figure 72 can be seen to parallel the first, just-described, example. In
20 the second example, document image portion 8910 is to be electronically linked to a piece of optically encoded data also comprised of two pieces: 8920 and 8930. Note however, that because 8910 represents the second portion of the document image to be electronically linked to optically encoded data, 9020 is marked with a "2". For corresponding reasons, 9050 and 9080 are also marked with a "2".

25 In Figure 73 a handwritten hardcopy document, 10010, is shown being fed into the document scanner of an ordinary facsimile machine, 10012. Document 10010 contains

portions to be electronically linked to electronic reference information. In the present illustration the electronic reference information is comprised of instructions and/or data which may be used to establish a connection with a remote location. As discussed earlier, whereas a variety of predetermined attributes of the document image may serve to identify electronically linkable portions, in Figure 73, delimiters are shown.

Figure 74 illustrates one embodiment of a *fall-back* option under the *Dual Disconnect Protocol* (D₂P) described in connection with Figures 48 and 58. In Figure 74 the sending station has already finished transmitting the electronic graphical representation of the document image, and is now attempting to negotiate an optimum mode for the automated transmission of electronic reference information to the receiving station. The embodiment shown represents but one possibility and is not meant to be limiting. After the sending station transmits the DCN signal (which would cause a conventional receiving fax apparatus to hang up) it sends the DTMF "*" tone of 941 Hz + 1209 Hz, followed by CNG which consists of an 1100 Hz tone that is intermittently on for 0.5 seconds and off for 3 seconds. The receiving apparatus responds by sending "VOA" to indicate that it is capable of receiving electronic reference information in an automated session from the sending station. A specific setup may then be negotiated between sending and receiving stations based on the capabilities common to both sets of equipment at the two locations. The electronic reference information may then be transmitted. These concepts would be appreciated by persons skilled in the art of handshaking procedures between pairs of communicating data transmissions devices. Also, while the sending station is depicted as sending a DCN signal followed by the "*" tone, this is not mandatory. It is not a requirement for the receiving station to operate in "Silent Answer Mode". In alternate embodiments the receiving apparatus may issue a response such as a tonal reply or voice message following receipt of the "DCN" signal from the sending station.

Figure 75 illustrates an example of a voice menu generated by the apparatus at the receiving station to assist an operator at the sending station through the process of creating electronic reference information for a fax document. The voice menu system of Figure 75 may be used even in the case where a fax document and its associated electronic reference information are transmitted using Simultaneous Voice-Data (SVD) technology. However, in Figure 75 it is depicted within the context of the Dual Disconnect Protocol (D₂P), because that communications scheme offers backwards compatibility with the prior art such as conventional facsimile machines operating on the public switched telephone network. It should be understood that the present invention is not constrained with respect to the temporal sequence in which a fax document and its associated electronic reference information is transmitted. In Figure 75, after receiving the "*" tone, the receiving apparatus may issue a series of messages 10059 as part of its voice menu, beginning with the announcement: "Entering Fax Phase II". This announcement, of course, is furnished for the sake of example and should not be construed as limiting. When the person at the sending station hears the desired option in the voice menu, that choice may be selected, 10063, by pressing the appropriate key on the telephone keypad. These practices are well known in the art of voice menu driven systems.

Figure 76 shows some of the voice menu options. For example, to create notes - including voice notes, one would press the "1" key to enter the notes menu, and then the "1" key again to access the audio sub-menu. Within the audio sub-menu additional instructions are furnished to assist a user through the process. 10087 shows part of the notes menu. 10089 shows some of the menu choices offered for the "*Talk-Back*" feature. The "*Talk-Back*" feature allows the recipient of a fax document to automatically establish a connection with a remote site, by simply selecting (such as by clicking on...) the portion of the fax document making the reference to the remote site. For example, if the remote site happens to be someone's voice telephone number, that telephone number will be

automatically dialed by the apparatus 1000. If the remote site happens to be a WEB site on the Internet, the apparatus 1000 will establish a connection to the Internet and then download the indicated information. 10089 in Figure 76 also shows that, for example, the key sequence "2" and then "2" and then "2" again permits an operator at a sending station
5 to designate a number for a fax-on-demand server.

Figure 76 illustrated how an operator at a sending station could use the voice menu system provided by the apparatus at the receiving station to manually select and then input electronic reference information to the receiving apparatus. Figure 77 shows how a telephone key pad 10140 may be used to pass alphanumeric information onto the receiving
10 apparatus. Methods for communicating alphanumeric information using a standard telephone key pad are known in the art. The e-Mail address: "sjr@nasa.org", 10162, may be keyed in by the sequence 10165. Similarly, the Internet Web address 10169 may be input using the sequence 10167. Also, while it is common practice to employ "dual-digit encoding" in inputting alphanumeric information using a telephone keypad, for instance,
15 the letter "s" is comprised of the key sequence 73 because "s" appears on the "7" key and is the 3rd choice out of the letters appearing on the "7" key: "PRS" - other arrangements are also possible. For example, triple-digit encoding may be used. It is also possible for embodiments of the receiving apparatus capable fo voice recognition to accept address information from the sending station in the form of a spoken human voice.

20 Figure 78 depicts the handwritten paper document 10010 of Figure 73 on the screen of the receiving apparatus. In the on-screen version of the document 10205, are four regions that are electronically linked to electronic reference information: 10220, 10223, 10225 and 10227. These regions correspond to the portions of the original that possessed the predetermined attribute designating them as link regions. This can be seen in Figure
25 73, where the names Mary, Steve, Sonia and Susan were enclosed in delimiters. Whereas link regions 10220, 10223, 10225 and 10227 may be displayed using highlight boxes, in

Figure 78 they are instead displayed in color, for example, in green. The method for accomplishing this, namely by re-mapping screen display attributes, has been taught above (See Figures 63, 64, 66, 68, 69, 71). Therefore, a user may designate just how linked regions are to be displayed on the screen; which is not always in highlight boxes. In

5 Figure 78 a cursor 10255, in the form of an arrow, is pointing to the name "Mary", 10227, which is linked to electronic reference information comprised of contact information. Whenever the cursor passes over a linked region its attributes are displayed. In the case of 10227, the portion of the document image containing the name "Mary" makes use of the "*Talk-Back*" feature of the present invention. Therefore, by double

10 clicking on the name "Mary" a recipient of fax document 10010 can have the receiving apparatus automatically establish contact with, for instance, Mary. The "What box" 10215 identifies the electronic reference information associated with the region "Mary", 10227, as that of a voice telephone number: "Telephone.Voice". The receiving apparatus knows this because the sending station, in using the "*Talk-Back*" feature 10089 in Figure 76, made a

15 selection from the menu which identified the input data as being "For Voice Telephony". The "Where-Box" 10210 shows the contact address, for example the voice telephone number: 535-3665. By pressing the "Open" button in the menu 10206, an operator will cause the receiving apparatus to establish a connection to the "*Talk-Back*" address, which in the present example, means dialing the voice telephone number 535-3665, and then

20 automatically turning on the microphone and speaker of the receiving apparatus (1000). A "*Talk-Back*" address can be other than a voice telephone number. For example, in Figure 78 it may also be a fax number such as 10236, a beeper number such as 10233, or an e-Mail address such as 10235, etc..

Figure 79 shows how a "*Talk-Back*" connection can be made from the Connection

25 Processor window. The option of using the Connection Processor window can be selected by a user from the "Preferences" option, which is accessed from the "Mode" button in the

menu bar 10206. When the cursor 10255 passes over a linked region such as 10277, the attributes of the link region are displayed, as in 10210 and 10215. If the cursor is then moved to another region of the document image that is free of linked information, the boxes 10210 and 10215 will be blank. However, by clicking once over a linked region the address associated with that region will be loaded into the information boxes 10210 and 10215, so that if the cursor then moves off of that linked region, and onto a link-free area, the already-loaded information will remain displayed in the boxes 10210 and 10215. A user may then click on the "Open" button in the menu bar 10206 to bring up window 10258 into the Connection Processor. Alternately (if this mode has been set), double clicking on a link region having a contact address will open the Connection Processor window 10258. It is also possible to select a setting whereby double clicking on a region having a contact address will directly cause a connection to be established, without the intervening Connection Processor window popping up. In Figure 79, the Connection Processor window 10258 displays the contact address, or "Target" 10247, as well as its "Type" 10249.

Figure 80 shows an example where a connection will be established with an alphanumeric pager. In the handwritten letter, 10205 of Figure 80, there is one person: Sonia 10223, who is to be contacted through her paging unit. When cursor 10255 is placed over the name "Sonia": 10223, the What-Box 10215 displays "Pager.Alphanumeric" to indicate that the address of "617.879.4321", which is displayed in the Where-Box: 10210, is for an alphanumeric paging unit. Pressing "Open" 10287 in the menu bar 10206 will bring up the Connection Processor window 10258. If Sonia's paging unit had been of the straightforward numeric-only variety, a connection would have been directly established - that is, the apparatus would have transmitted its own number to Sonia's device. However, because Sonia's unit is an alphanumeric pager, the Connection Processor window

opens to let the operator input text to be sent to Sonia's alphanumeric pager. This is illustrated in Figure 81.

Double clicking on "Sonia" 10223, or single clicking on "Sonia" 10223 and then pressing the "Open" button in menu bar 10206 causes the Connection Processor window 5 10258 to pop up in Figure 81. This time, the "Type" identifier 10249 displays "Alphanumeric Pager", and the "Target" identifier 10247 shows the pager's number. Text entry box 10264 is provided for entering text to be sent to the paging unit. Note that the cursor 10255 transforms itself into an I-Beam 10269 when it is situated within the text entry box 10264. Pressing the "Yes" button 10273 will cause the text entered in the text 10 entry box 10264 to be sent to the alphanumeric pager at the "*Talk Back*" address specified.

Figure 82 illustrates a handwritten letter 10510 that includes a "*Talk-Back*" address in the form of an Internet World Wide Web address. In Figure 82 an individual has pasted a business card 10520 to a handwritten letter 10510. That business card includes references to an ordinary telephone number, a fax-on-demand number, and the URL of a company's 15 web site. As a convenience to the intended recipient of the letter, the author of the letter wishes to make use of the "*Talk-Back*" feature of the present invention to enable the receiving apparatus to automatically contact the company named in the attached business card for the addressee. The linked portions of the fax letter are chosen to be 10550 and 10530, because these are the portions of the attached business card which display contact 20 information. They are designated using delimiters 10555, although, as mentioned repeatedly above, this is not the only means for designating linked portions.

In Figure 83 the letter 10510 is sent using a conventional facsimile machine 10012; the pertinent "*Talk-Back*" information is then keyed in using the telephone keypad 10140. The Web address "www.pie.com", 10165, is entered as the sequence of numbers depicted 25 as 10167. The fax number 10171 is entered as the sequence of numbers 10173. And, similarly, the voice phone number 10175 is input as the numeric sequence shown as 10177.

Figure 84 shows how the business card 10520 of Figure 82 appears on the screen of the receiving apparatus. Notice that the delimiters 10555 have been auto-erased as taught in connection with Figure 71, and thus do not show up on 10521. When cursor 10255 moves over region 10551, the "Where-Box" 10210 reveals that the "*Talk-Back*" address is that of a Web site: "www.pie.com". The "What-Box" 10215 indicates that the region 10551 possesses two "*Talk-Back*" addresses, and that the web address of "www.pie.com" is only the first of the two: "[1 of 2]". The "What-Box" 10215 further shows that the web address "www.pie.com" is the only web address present "(1/1)". For example, had there been another web address reference, the "What Box" 10215 would have instead showed "[1 of 3] Web (1/2)". The business card 10521 in Figure 84 also includes a reference to a voice telephone number, which is associated with region 10531. Notice that an up arrow 10277 and a down arrow 10278 have appeared adjacent to the "What" and "Where" boxes. These permit a user to scroll to specific "*Talk-Back*" addresses when there are a plurality of such addresses associated with a particular region of the document image. If the user were to press the "Open" button 10287 now, a connection to "www.pie.com" would be established by the Connection Processor in fulfillment of the "*Talk-Back*" request made by the user. Thus a fax document, which may even be handwritten, and which may be transmitted using an ordinary facsimile machine, can allow the recipient of the document to establish contact with a Web site by simply selecting the portion of the received fax document that refers to the Web reference.

Figure 85 shows the use of the down arrow 10278 to scroll to the second of the two "*Talk-Back*" addresses linked to region 10551. The cursor 10255 is illustrated on top of the down arrow 10278. The "What-Box" 10215 accordingly indicates that the second "*Talk-Back*" address supplies a Fax-On-Demand number. Pressing "Open" 10287 will cause a connection to be established to the Fax-On-Demand server at the number indicated in "Where-Box" 10210.

Figure 86 shows another example involving a "*Talk-Back*" address comprised of a Web site. Consider the following scenario. A person sees an advertise for a theatre in the bus on the way to work. Anxious to obtain show information, she calls while still on the bus, using her cellular phone, the number displayed in the ad. The theatre's fax-on-demand server answers her call and processes her request for information, in a manner well known in the art of fax-on-demand devices. She gives it the number of her fax tablet (i.e. device 1000 of Figure 41) which is sitting in her office charging. By the time she arrives at work, document 12210 shown in Figure 86 has already been received by her fax tablet. In document 12210 is an icon, 12220, depicting a butler, or "server", seen holding a tray containing a computer - which is serving documents. This icon may be clicked on to retrieve from the theatre's web site a symbolically encoded version of document 12210; which may be desirable in instances where the received fax document is not completely clear. Thus clickable icon 12220 furnishes the option of obtaining an "Internet copy" of the document, when they are available. Highlight boxes 12231 and 12233 are regions which enable automatic connections to be made to voice telephone numbers, via the "*Talk-Back*" feature of the present invention. 12237 re-establishes contact with the fax server which originally sent document 12210. And, 12235 generates a connection to an "STS" server (Station-To-Station Server), which is discussed in a co-pending patent application. The box labeled "December", 12215 in Figure 86, contains a link to the theatre's web site which is represented as 12240. Therefore, by clicking on 12215 a user may access the web page 12240. Within the web page 12240 are buttons 12251 for seeing video sequences of sneak show previews; 12253, for obtaining ticket information; and 12255, which retrieves a seating plan for the theatre. The just-mentioned concepts which relate to operation solely within the context of the Web are known in the art, and, in the absence of regard for connectivity *from* an ordinary fax document, are also extraneous to the object of the present invention.

Because the apparatus 1000 may be operated as a portable unit communicating over a cellular connection (see Figure 43a), it is desirable that the cellular connection be as resistant to cloning as possible. Figures 87 and 88 illustrate one embodiment of a system using "Dynamic PassCode Protection" to hinder cellular cloning. In particular, Figures 87 and 88 depict a specific embodiment of Dynamic PassCode Protection using a "Dual Component" approach.

In Figure 87, a portable apparatus 1000 is establishing a connection with the nearest transmission station 13107 of a cellular service provider. In current art systems identification information is transmitted by the mobile unit to identify itself to the cellular service provider. More recently, in addition to the identification information, a PIN number is also transmitted. With the *Dual Component Dynamic PassCode* approach taught herein, the conventional PIN number is replaced by a PassCode which is the equivalent of the PIN number, except that the PassCode is changed immediately following the successful establishment of a cellular connection. Therefore, immediately following establishment of a connection, the just-used PassCode is invalidated. Thus if it is intercepted by a cellular thief it will no longer be of use. The algorithm applied to generate the dynamic passcode is contained in the firmware of the apparatus 1000; it is also known by the computer of the cellular service provider so that both may generate new passcodes in synchrony. A multiplicity of algorithms may be available such that any two portable units 1000 have a low statistical likelihood of having firmware containing the same algorithm. Also, the algorithm is contained in the firmware of the apparatus 1000 so that it will be more difficult to re-program with a new algorithm. Only the manufacturer of the apparatus 1000 knows which algorithm is contained in any given unit, although the necessary data associating each unit with its algorithm is passed on to the cellular service provider. It is further possible for each apparatus to include multiple algorithms, one of which may be designated as active at the time cellular service is first initiated. As shown in Figure 87,

the PassCode is generated preferably using two functions: "f" and "g". First, a dynamically changing variable is generated based on a function "g" of a number referred to as the "Co-PIN Number". The actual PassCode itself is then generated based on a second function "f" of the user's PIN Number and the dynamic variable g(Co-PIN #). Thus

5 ***PassCode = f(PIN #, g[Co-PIN #])***. The dynamic variable may be furnished by a number generator (i.e. function "g") which uses the Co-PIN# as its "seed", for instance. Variations on the theme are also possible, for example, using g(PIN#, Co-PIN#) either with another function "f" or alone, etc. It is also possible for the PassCode to be calculated using only the Co-PIN#.

10 Figure 88 shows one method of synchronizing the Co-PIN Number between a cellular service provider and a cellular customer. It is preferred that a cellular customer call, using a conventional wired line, a telephone number reserved for establishing Co-PIN Numbers by the cellular service provider (e.g. 1.800.GetCode). Upon reaching a computer at the called number, the customer would provide information such as the phone number of
15 the portable unit and the PIN #, and obtain in return from the computer, a new Co-PIN #. This may be done as frequently as desired. However, although it is not preferred, an optional method for obtaining Co-PIN numbers using a cellular connection is illustrated in Figure 88.

In Figure 88 a portable apparatus 1000 receives a "Secure Envelope" 13126, from
20 the nearest transmitting station 13107 of the cellular service provider. The Secure Envelope contains the new Co-PIN Number 13133. In order to "open" the Secure Envelope 13126, the customer's PIN Number 13129 is required. The Secure Envelope may comprise any suitable scheme known in the art of data encryption for encrypting, or for otherwise containing or conveying the customer's Co-PIN # 13133, such that the PIN
25 Number may be applied to extract the Co-PIN #.

The method shown in Figures 87 and 88 therefore offers a dynamic PassCode in place of the static PIN number currently used in the art. Additionally, the algorithm used to generate the dynamic passcode varies with the apparatus so that even knowledge of the correct PIN# and Co-PIN# is insufficient. Further, the customer's PIN# is never
5 transmitted over the airwaves, and so is kept confidential. Still further, even when the Co-PIN# is transmitted over a cellular connection, it is contained within a Secure Envelope so that its interception alone is inadequate.

Figure 89(a) shows a hardcopy page 70300 onto which a series of shapes are being drawn by hand. A rectangular box is already present, which is seen in the process of being
10 sub-divided into two portions by a horizontal line. Figure 89(b) illustrates what Figure 89(a) may look like when complete. An outer rectangle, with vertices V1:V2:V4:V5, contains two smaller rectangles: an upper one with vertices V1:V2:V3:V6, and a lower one with vertices V3:V4:V5:V6. Figures 89(a)-(c) illustrate the concept of the "Frame Control Page". Frame Control Pages permit a sender having no more than a conventional
15 facsimile machine and a marking implement such as a pen, to convey to the receiving apparatus 1000 how a collection of fax documents should be organized. For example, the display of the receiving apparatus may be partitioned into multiple frames, with some documents (or portions of some documents) appearing in certain frames, and other documents (or portions of them) appearing in other frames. Any particular frame may be
20 used to display document information to a viewer, or to present electronic reference information, or even to offer functional controls such as navigation or other programmable features. The examples provided herein are merely for purposes of illustration and are not a limitation of the invention. Also, whereas the frame control information is shown as being drawn by hand, they may equally being mechanically produced, or electronically

generated. Figure 89(c) shows a frame declaration that creates two frames comprised of a narrow vertical column and a broader frame adjacent to it.

Figures 90 (a)-(c) show some examples of frame control language that the apparatus 1000 will identify using pattern recognition automatically performed on frame control
5 pages. Figure 90(a) shows a hardcopy page 70300, which may have been drawn by hand on a regular piece of paper (though this is not a requirement). 70305 depicts a frame definition comprised of two parts: an upper frame 70307, and a lower frame 70309. In Figure 90(b) the upper frame 70307 contains a crossbar 70310. The crossbar tells the receiving apparatus that the frame that contains it, which in the present case would be the
10 upper frame 70307, is to be non-resizable. Figure 90(c) shows other information which may be conveyed by a frame control page. The markings 70312 on the vertical pane of frame 70307 specify that: "No Vertical Scroll-Bars" should be included for the upper frame 70307. In the absence of the marks 70312 in the frame definition, scroll-bars are added automatically by default if they are needed to size-wise accommodate the document
15 displayed in the frame. Figure 90(c) also includes the specification 70314 for excluding horizontal scroll-bars from the bottom frame 70309. This and other frame information may be conveyed to, and obtained by, the apparatus 1000 through pattern identification automatically performed by the apparatus on the fax images it receives.

Figures 91(a)-(f) illustrate a practical application of frame control to a fax
20 transmission. Figure 91(a) shows a frame declaration which creates two frames for received fax information: an upper frame and a lower frame. As shown in Figure 91(b), a page containing a depiction of the upper frame 70307, alone, precedes the document pages that are to be placed into that particular frame. This serves to inform the receiving apparatus that "what follows in the incoming fax document stream goes into the upper
25 frame". Figure 91(c) represents the actual fax documents to be displayed in the upper frame 70307. Figure 91(d) shows a page containing a representation of the lower, frame

70309, of the two frames declared in Figure 91(a). This page precedes the second set of fax documents, and informs the receiving apparatus that "what follows in the incoming fax document stream goes into the lower frame". Figure 91(f) shows how the received documents appear on the display of the receiving apparatus 1000. Notice that
5 "Document(1)" of Figure 91(c) is displayed in an upper frame 70316, and that "Document(2)" of Figure 91(e) is displayed in a lower frame 70317. Horizontal 70320, and vertical 70321 scroll-bars permit the respective documents to be moved around for viewing within their individual frame space.

Figures 92(a)-(c) offer additional examples of frame control language syntax.
10 Figure 92(a) shows two pages: a first page which contains a frame declaration, followed by a second page, "prefix page", which tells the receiving apparatus that "what follows is associated with frame 70307". In Figure 92(a) all of the frame specifications are included with the first frame control page, which is then followed by the prefix page. In contrast, in Figure 92(b) the first frame control page merely comprises a frame declaration to create
15 two (in this example) frames. The prefix page then contains the frame specifications for frame 70307. Although Figures 92(a) and (b) convey identical information, the manner in which this identical information is conveyed is different. Both are syntactically correct with respect to frame control language interpreted by the apparatus 1000. Figure 92(c) depicts yet another syntactically acceptable way to express frame control information
20 identical to that of Figures 92(a) and (b). Here however, an addition page is used to tell the receiving apparatus that no scroll-bars should be present in either vertical or horizontal directions in frame 70307. By permitting the use of additional pages to convey information, commands can be distributed.

Figure 93 shows how a "Navigational Table of Contents" may be created for a
25 lengthy fax document comprised of a large number of pages, to facilitate movement through the entire document by the reader. First, in Figure 93(a), a frame declaration is

provided to establish that there will be two frames: 70307 and 70309. Following this, in Figure 93(b), is a prefix page, which in the present illustration will result in a non-resizable and scroll-bar free navigational control frame. Figure 93(c) shows a page of text containing the numbers "1" (70325), "2" (70326), and "3" (70327); they have been
5 marked in accordance with the teachings above in connection with Figures 64 and 65. The text numerals associated with portions 70325, 70326, and 70327 will be electronically linked to faxed material located at successively later positions in the overall fax document stream. Figure 93(d) shows a prefix page for demarcating the beginning of information to be associated with the lower (frame 70309) of two frames. Figure 93(e) shows a block of
10 fax pages commencing with the text: "Part I" (70330), which is the link target of the text: "1" (70325) appearing in Figure 93(c). Similarly in Figure 93(f), is a block of fax pages commencing with the text: "Part II" (70333), which is the link target of the text: "2" (70326) appearing in Figure 93(c). In Figure 93(g) a block of fax pages commencing with the text: "Part III" (70335), is the link target of the text: "3" (70327) in Figure 93(c).
15 Figure 94(a) shows how the material of Figure 93 appears on the receiving apparatus 1000. Observe that the text "1" (70325), "2" (70326), and "3" (70327) are in a static frame at the top of the display, and that the predetermined attribute (double-bracket delimiters, in this example) have been auto-erased in accordance with the teachings associated with Figure 71. Figure 94(b) shows how when "2" is clicked on, in the upper
20 frame comprising the navigational table of contents, the text 70333 supplying the link target of 70326 is displayed at the top of the lower frame. Scrolling the lower frame with either a mouse, keyboard arrows, or other GUI steering means will cause the document downstream of 70333 to move accordingly. For example, pressing the keyboard down arrow will cause the information displayed in the lower frame to move upwards, with "Part
25 II" (70333) disappearing off the display. Similarly, pressing the keyboard up arrow causes the document to scroll downwards so that material in Part I of the document may be

accessed. Figure 94(c) shows the consequence of clicking on the text "3" (70327) in the upper navigation frame: that is, "Part III" (70335) is accessed in the bottom frame.

Figure 95 illustrates a concept referred to herein as the "Java Stick-Note". This terminology is not to be construed as limiting but merely as being applied to provide an illustration. That is, languages other than Java may be used. For example, JavaScript, 5 ActiveX, VBScript, C++, etc.. Figure 95 shows a hardcopy page 70300 having a frame declaration 70305. The frame declaration and specifications, 70305, may be hand drawn, mechanically imprinted, electronically generated, or otherwise synthesized. 70307 is on a prefix page which tells the receiving apparatus that the documents which follow belong in 10 the upper frame. 70345 represents a region which has been marked to serve as the link source of optically encoded electronic data. The region defined by 70345 defines the applet space on the fax page. The document image processing language is as taught in connection with Figure 72. 70347 represents a "Java Stick-Note". "Java Stick-Notes" are 3M-type stick notes with (for example) Java or JavaScript programs imprinted on their non- 15 adhesive side in optically encoded format. As with conventional 3M stick notes, they may be provided in the form of pads. In Figure 95 the Java Stick-Note 70347 has been placed onto a sheet of paper that is included in the document stream being faxed to apparatus 1000. 70309 is on a prefix page which signifies the start of a block of document pages belonging with the lower frame. 70348 denotes the start of the document pages which go 20 into the bottom frame.

Figure 96 shows how the data of Figure 95 appears when received by the receiving apparatus 1000. First, notice that there are two frames: an upper one and a lower one. Second, the upper frame has no scroll bars. The text 70346 of Figure 95 can be seen in upper frame of Figure 96. The upper frame of Figure 96, however, also includes "new" 25 material which on the surface was not present in the corresponding document portion in Figure 95. This "new" material comes from the Java Stick-Note. It does not appear to be

present in Figure 95 because it existed in optically encoded form in the Java Stick-Note 70347 of Figure 95. In the example, an animated cartoon character 70355 is waving. There is also what is commonly referred to as a scrolling "LED sign" 70353, displaying the message "CALL US". The document 70348 is seen in the lower frame. While
5 information contained in the lower frame may be scrolled for viewing, material in the upper frame is static. Static frames are convenient for presenting business letterhead information, or banners, possibly animated or otherwise dynamic, used to convey messages of special emphasis, and also for containing programmable features such as control buttons and menu items.

10 Figure 97(a) shows a business card 70360 having optically encoded programmable content on the back surface of the card. The programmable content may rely on Java, JavaScript, ActiveX, etc.. 70361 represents the optically encoded data. 70345 is the portion of the page (applet space) where the programmable content will run. The document image processing language is as taught in connection with Figure 72. Note that
15 in Figure 97(a) the business card 70360 is shown mounted face-down, or "data surface up" on a piece of paper 70369. When received by the receiving apparatus 1000, pages 70368 and 70369 result in the document shown in Figure 97(b). The graphic 70347, which may be animated; the phone number 70348, which may be auto-dialed in accordance with the teachings of Figures 78-86; and the "Order Now" button 70349 are supplied by the
20 optically encoded information 70361 on the back of the otherwise conventional business card of Figure 97(a). Figure 97(c) illustrates what may happen when the "Order Now" button 70349 of Figure 97(b) is clicked on. The order form of Figure 97(c) may be generated by programmable information contained in the optically encoded data 70361 of the business card 70360. It may also come from an Internet Web site. In the latter case
25 the business card may simply contain the Web URL of the "Pastry Order Form", for

example, "http://www.pie.com/order". In either case, the information entered by the user may be submitted to a CGI-Script for processing.

Figure 98(a) shows a frame declaration to create a fax receiving container comprised of three frames. Figure 98(b) shows two sheets used to define a header frame that is non-resizable and non-scrollable. Figure 98(b) also shows that the name of a company: "BullWinkle & Assoc's" will be placed into the header frame. Figure 98(c) shows the frame control language that is used to "accumulate" all link sources encountered in the (total) fax document stream, and place them in a columnar frame. Figure 98(d) depicts a document.

Figure 99 shows how the information in Figure 98 is treated by the receiving apparatus 1000. The top most frame 70370 displays the header text of Figure 98(b). The actual document (which includes an assortment of links and link types) is displayed in frame 70374. This is the document of Figure 98(d). In frame 70372, all of the link sources of the document of Figure 98(d), which is viewable in frame 70374, have been "accumulated" and are on display. Note that in frame 70372, the link sources: 70377, 70378, and 70379 can also be seen "in context" in frame 70374. Figure 99 thus illustrates an example of an accumulated link source frame. The concept of the accumulated link source frame should not be confused with the concept of the navigational table of contents taught in connection with Figures 93 and 94. The objective of providing a navigational table of contents was to simplify movement (that is, access or viewing) within a lengthy fax document. The purpose of accumulating link sources is to allow rapid access to any information, connection, or function which is linked to some portion of the overall document being viewed.

When the "Synch On" (70380) feature is switched on, whenever a link source is selected, i.e. clicked on, in the frame 70372, the corresponding portion of the document which contains that link is displayed in the frame 70374 so that the link source may also be

seen "in context". At the same time, the target of the link is executed, and if necessary, a separate window as illustrated in Figures 67, 79, 81, is opened to act as a container for the target contents. Direction arrows 70382 may be used to return (or advance) to a different position in the document being viewed in frame 70374 after a link source button has been
5 clicked on in frame 70372. For example, clicking on the left arrow would restore the displayed document in frame 70374 to where it was prior to the time the last link source button was clicked on in frame 70372.

Figures 100(a)-(c) illustrates a frame declaration in which an accumulated link source frame is created, but also a frame to serve as a container for link targets. Figure
10 100(a) creates a three-frame container for received fax information. Figure 100(b) establishes that link sources are to be accumulated in the top-most frame. Figure 100(c) defines the link target frame which will act as the container for links clicked on in the link source frame of Figure 100(b).

Figures 101 and 102 illustrate how HTML is generated for fax documents
15 conforming to the teachings contained herein. In Figure 102, an entire fax page constitutes one fax image, and the top left pixel of that fax image has a coordinate of (0,0). Fax images may be saved in GIF format if desired. Similarly, reference information may be saved in HTML, WAV, MPEG, (JAVA) CLASS, etc. format if desired.

The presently disclosed embodiments are to be considered in all respects as
20 illustrative and not restrictive, the scope of the invention being indicated by the appended claims, rather than the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.